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HOG CHOLERA



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HOG CHOLERA

ITS

NATURE AND CONTROL

BY

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PREFACE

My object in preparing this book has been to place in the hands of those who handle hog cholera definite and authoritative information regarding the disease. There are abundant publications dealing with hog cholera but for the most part they consist of technical papers covering certain restricted phases of the disease, or of attempts to circumscribe the entire subject in the scope of a few pages. Neither meets the needs of the man who must handle hog cholera in the field. Moreover these publications appear as bulletins or as special papers in technical journals, and usually they are not at the veterinarian's command at the time he needs them.

We are rapidly discarding the old belief that any one who can use a hypodermic syringe can cope with hog cholera. Questions constantly arise regarding diagnosis, complications, when or whether to immunize, which method to use, the subsequent care of the herd, the handling of young pigs, slaughtering from infected herds under inspection, and many other individual problems.

The effective handling of hog cholera, like the handling of other diseases, is founded on exact knowledge of the malady itself, but hog cholera differs from other infectious diseases in that preventive vaccination against it has served to open the new field of swine practice.

The result is that there are many veterinarians who will not attempt to cope with the disease, or who, making the attempt, feel the need for guidance.

This volume is in no sense a compilation. For the most part it reflects personal experiences gained during ten years of intimate contact with hog cholera in the capacity of practicing and consulting veterinarian, anti-hog-cholera serum producer and research worker, but acknowledgment is due many other members of the veterinary profession whose researches and observations have revealed many of the foundation facts on which the subject matter rests. For statistical and other data I have consulted other authors freely, relying for statistics especially on the numerous and excellent publications of the United States Bureau of Animal Industry. I am indebted to Dr. E. A. Cahill, Director of the Pitman-Moore Biological Laboratories, Zionsville, Indiana, for some of the illustrations.

Dr. V. A. Moore, Dean of the New York State Veterinary College at Cornell University, and Dr. J. W. Benner of the College Experiment Station Staff have read the manuscript, and each has offered many valuable suggestions which are deeply appreciated.

Great care has been taken to make the book a conservative and accurate guide for the practicing veterinarian who must accept farm conditions as he finds them and handle hog cholera so as to secure and retain the confidence of his clients. If among other imperfections there are departures from this ideal I trust that my readers will direct my attention to them.

R. R. B.

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HOG CHOLERA

CHAPTER I

HISTORY AND ECONOMIC IMPORTANCE

Hog cholera seems to have appeared first on American soil in 1833, at which time an outbreak of the disease was reported in the Ohio valley. It is not definitely known whether the malady originated in this country or in Europe, but it is a rather significant fact that the wild hog has flourished in Eurasia, and not in North America, in spite of the fact that the fauna of the two continents are in most other respects very closely related. It is also of special significance that the earliest authentic report we have of the disease in this country was made at a time when railroads were first being put into operation. It is therefore possible that it really existed in America prior to that time, and that lack of facilities for its rapid spread prevented it from assuming the proportions of an epizootic.

It is true that as early as 1822 an epizootic disease resembling hog cholera was reported in

France, and there is evidence that prior to 1833 outbreaks of a similar nature occurred in other parts of continental Europe. But even with present-day knowledge hog cholera and other infectious swine diseases are sometimes difficult to differentiate, and we are thus in the dark relative to the true causes of all the earlier outbreaks.

According to the most authentic records, hog cholera appeared in England in 1862, and from there, in 1887, it was carried to Sweden in a shipment of boars. In this same year the disease appeared in France and Denmark, and its spread was so rapid and persistent that all European countries have suffered severely from its ravages. To-day, no large area devoted extensively to swine raising is entirely free from hog cholera, and so far as we have been able to ascertain, no country, once invaded, has succeeded in freeing itself of the malady. The Scandinavian countries seem to have suffered least from its effects.

Because of its rapid spread and high mortality hog cholera has caused and is causing enormous losses, the estimate being that in the United States it is responsible for ninety per cent of the deaths from all swine diseases. In this country the annual losses caused by it during the last four decades have ranged between \$13,000,000 and \$200,000,000, and in the two decades ending with the year 1914 the average annual loss per one

thousand hogs has been approximately 66. In 1897, the loss per thousand ran as high as 130. Since 1914, the losses due to the disease have been gradually diminishing, and it is believed that more effective sanitary measures and more extensive and judicious use of protective serum have been responsible for this decline.

Naturally a disease of such great economic importance has been the object of close and prolonged study. In 1875, Dr. James Law furnished the United States Department of Agriculture with a report setting forth accurately the symptoms and lesions of the disease, and speaking for its transmissibility. Three years later, as a member of a commission of nine men appointed by the Department to investigate the disease, he succeeded in transmitting it by inoculation experiments. Dr. Detmers, acting as a member of the same commission, isolated an organism which he regarded as its cause, but his findings were not confirmed.

In 1885, Dr. Daniel Elmer Salmon and Dr. Theobald Smith isolated an organism, now known as *B. suispestifer*, which they believed to be the true cause of hog cholera. Their work was confirmed by trained investigators in this country and Europe, but all attempts to produce immunity to field outbreaks by using *B. suispestifer* as an immunizing agent ended in failure. Thus during the late nineties considerable doubt had developed

among some scientists relative to the true significance of this organism in its relation to epizootic hog cholera. This doubt was aroused because hogs that sickened as a result of injections of *B. suispestifer* cultures failed to transmit disease to checks, because those that survived injection with cultures of the organism were not immune when exposed in field outbreaks, and because these cultures did not always produce disease, while blood from hogs sick as a result of natural infection proved to be quite generally infectious. In 1903, de Schweinitz and Dorset of the United States Bureau of Animal Industry demonstrated that the true cause of epizootic hog cholera is a filterable virus, and this marked an epoch in the history of the disease.

Proceeding in the light of this new knowledge, Dorset, Niles and McBryde succeeded, in 1908, in adapting to hog cholera the principles employed by Kolle and Turner, Nicolle and Adil-Bey in producing a protective serum against rinderpest, a disease of cattle caused by a filterable virus. The work of Dorset and his associates was confirmed by numerous investigators, among whom were Uhlenhuth, Hutyra and Xylander, and the epochal field experiments conducted in this country by Dr. Niles and described by him in the report of the United States Bureau of Animal Industry, 1908, fully established the great practical

usefulness of anti-hog-cholera serum in checking the inroads of hog cholera in the field.

Since 1908, rapid advances have been made in providing for an adequate supply of serum, in refining it, in working out methods for its use in the field, and in regulating its production so as to prevent sale of that which is contaminated or impotent. All important hog-raising states in the Union have made provision to manufacture serum, and scores of private laboratories which have been established are being operated under supervision of the Bureau of Animal Industry. In the refinement of the serum the aim has been to produce, at low cost, a clear, sterile, potent product with good keeping qualities. This ideal is rapidly being attained, but there are still serious questions regarding uniform potency and keeping qualities of the clear serum, and the equipment required in making it is rather crude, and cannot be said to have passed the developmental stage.

Finally, it should be related that with the knowledge that hog cholera can be controlled, there has appeared a quickened interest in all other maladies that affect swine, especially those frequently complicated with hog cholera. Undue importance has sometimes been attached to some of these diseases, and such extravagant claims have been made for certain biologics used as prophylactic or therapeutic agents that there has

been a sharp reaction, and there are indications at present that the trend of opinion may even swing too far in the opposite direction. The diseases that complicate hog cholera present very real problems, and experimental work looking toward a deeper understanding of them is one of the immediate needs of the present day.

CHAPTER II

NATURE AND CAUSE OF HOG CHOLERA

Hog cholera is an acute, communicable, febrile disease which attacks swine of all breeds and ages, but does not affect other domesticated animals, or man. It is a septicemia. Occasionally a peracute form of the disease is recognized during the first days of an outbreak and chronic hog cholera is frequently observed among the stragglers that survive the more severe and rapidly terminating forms. In the individual, the disease is characterized by sudden onset, inappetence, chilling, very high fever, arched back, a disposition to hide in the litter, constipation followed by diarrhea, general weakness in the later stages, accompanied by purplish discolorations of the skin covering the belly, ears and snout. In the herd, the onset is relatively slow, the first death usually preceding subsequent ones several days, but after the first week the outbreak rapidly gains momentum, and in a comparatively short time all hogs become infected. The mortality ranges between 80 and 100 per cent with a strong tendency to approach the latter figure.

Young pigs, especially those farrowed and nursed by immune mothers, are often immune to cholera during the first few weeks of life, and a general impression that all pigs nursing immune sows are likewise immune seems to have gained ground. This impression is not in accord with the facts, for we have seen individual pigs born of immune mothers and suckled by them, dead of hog cholera on the seventh day following birth, and under like conditions of birth and sustenance we have frequently seen entire litters succumb to the disease before attaining an age of four weeks. Among older hogs raised in localities where hog cholera is not prevalent, the "natural immunes" so frequently mentioned are by no means common, and it is probable that in places where they are found in considerable numbers they owe their immunity to the fact that they are exposed to cholera as young pigs, and suffering only a slight reaction, are rendered immune. As a general rule, young shoats, old hogs, and sucking pigs are most susceptible to cholera in the order named, and, as would be expected, recoveries from the disease are less frequent among young shoats, and more frequent among old sows and sucking pigs.

The cause of hog cholera is a filterable virus, probably an organism too small to be visible with the highest magnification now obtainable, and possibly possessed of characteristics which prevent it

from taking stains that render bacteria more plainly visible. The virus readily passes porcelain and infusorial earth filters which retain all visible bacteria, but it is itself retained by the finest porcelain filters. It does not pass through colloid membranes. In the human subject, measles, mumps, scarlet fever and smallpox are among the diseases caused by filterable viruses, while among animals rinderpest, foot-and-mouth disease and rabies are some of the diseases that fall in the same group. The classification is a rather loose one, being based entirely on the fact that these viruses will pass filters that retain visible bacteria, rather than on morphological or cultural characteristics.

There is no conclusive evidence that hog cholera virus has been propagated outside the bodies of infected swine. After a hog has been exposed to the disease and actually infected, the virus appears in the blood stream in about four days, and thus all vascular organs harbor it during the attack. In the later stages of a few chronic cases, we have found the blood free of the virus, but we do not know whether this is the rule, nor is there definite knowledge of the part played by "carriers" in harboring it. It is eliminated through the excretions. The urine is regularly infectious, the feces may or may not contain it, and the discharge from the eyes and skin ulcers is infectious

at least in some instances. Just how any one of the filterable viruses operates to produce disease is quite unknown, but it is certain that hog cholera virus has a selective action for epithelial and endothelial cells.

Virulence. Hog cholera virus produces specific disease only in swine, and very small quantities of infected material are sufficient to cause death in susceptible animals. According to King, subcutaneous injections of 1/86 of a mil of virulent blood produced the disease, while lesser amounts produced only a mild reaction, or none at all. Natural infection usually occurs by way of the digestive system, but the disease is readily produced by subcutaneous, intravenous or intra-abdominal injections of small quantities of virulent material.

Resistance. Most of the natural influences to which hog cholera virus is subjected do not operate to destroy it rapidly. Drying, sunlight, and low temperatures seem to have no immediate attenuating effects, although it is a fact that most infected yards which remain uninhabited from three to six months do not endanger susceptible pigs placed in them. There is, though, a considerable tendency for hog cholera to recur on old infected farms, and this fact indicates that there are exceptional cases in which the span of life of the virus is greatly prolonged.

Putrefaction is the only natural influence which operates to destroy the virus rapidly. According to Uhlenhuth it will live in putrefying carcasses for about eight days, but undoubtedly the many influences which govern putrefactive processes render data of this kind of value merely in establishing tendencies. It is certain that decomposing carcasses do not harbor the virus regularly, and likewise it is true that virus kept in bottles in the laboratory often is killed when putrefaction develops. When sufficient preservative is added to prevent the growth of putrefactive organisms, the virus regularly lives several months, and may even exist for years.

Moderate degrees of heat attenuate or destroy the virus, and under no circumstances has it been found to survive temperatures near the boiling point. The following rather incomplete table prepared by the German Imperial Board of Health laboratories gives a fair idea of the effects produced by various degrees of heat.

<i>Material</i>	<i>Degrees Centigrade</i>	<i>Time</i>	<i>Results</i>
Liquid serum filtrate	45	24 hours	Not killed or weakened
Liquid serum filtrate	46.5	24 hours	Not killed or weakened

<i>Material</i>	<i>Degrees Centigrade</i>	<i>Time</i>	<i>Results</i>
Liquid serum filtrate	46	48 hours	Killed
Liquid serum filtrate	55	24 hours	Killed
Liquid serum filtrate	60	10 hours	Killed
Liquid serum filtrate	58	2 hours	Not killed
Liquid serum filtrate	78	1 hour	Killed
Dried blood	65	2 hours	Not killed
Dried blood	72	1 hour	Killed
Dried blood	72	1/2 hour	Killed
Urine	58	1 hour	Killed
Urine	58	1/2 hour	Not killed

Low temperatures act to prevent growth of putrefactive organisms and are thus instrumental in prolonging the life of the virus. In our own experiments, hams removed from cholera infected pigs and frozen hard ninety-three days still harbored virus sufficient to produce the disease when small portions of them were fed to susceptible pigs.

Disinfectants. Hog cholera virus readily resists ordinary disinfectants in dilutions that are rapidly fatal to most bacteria. When 1/2 per cent phenol is added to virulent blood, the virus will remain alive for months, and all of the coal tar disinfectants must be prepared in strong solutions in order to destroy it. Liquor cresolis compositus

in 5 per cent aqueous solution, when allowed to act for an hour or more, has proved effective in killing it. Following is a table prepared by the German Imperial Board of Health laboratories, which furnishes additional information relative to the effectiveness of various disinfectants when used to kill hog cholera virus. Most of the tests were made by mixing 10 mils of the virus with an equal quantity of aqueous dilution of the disinfectant.

<i>Disinfectant</i>	<i>Dilution applied</i>	<i>Result</i>
Corrosive sublimite	0.3 per cent solution	Serum filtrate not killed in 8 days.
Corrosive sublimite	0.5 per cent solution	Serum filtrate virus not killed in 4 days.
Corrosive sublimite	0.2 per cent solution	Urine virus killed in 15 minutes in one trial. In another trial not killed.
Carbolic acid	0.5 per cent solution	Serum filtrate virus not killed in 8 days.
Carbolic acid	1.0 per cent solution	Serum filtrate virus not killed in 4 days.
Carbolic acid	3.0 per cent solution	Failed to kill blood virus in 8 days.
Carbolic acid	2.5 per cent solution	Failed to kill urine virus in 15 minutes.

<i>Disinfectant</i>	<i>Dilution applied</i>	<i>Result</i>
Chloroform	Full strength	Serum filtrate virus not killed in 24 hours.
Sodium taurocholate		Blood virus not killed in 4 days.
Formaldehyd	2.5 per cent solution	Serum filtrate virus alive after one hour. Dead in 15 days.
Lugol's solution	0.25 per cent solution	Failed to kill serum filtrate virus in 2 hours.
Urea	20.0 per cent solution	Did not kill serum filtrate virus in 1 month.
Glycerin	33.0 per cent solution	Failed to kill serum filtrate virus in 1 month.
Ozone	Blood virus not killed.
Hydrogen peroxid	10.0 per cent solution	Serum virus not killed in two hours.
Antiformin	5.0 per cent solution	Serum filtrate virus killed in one hour.
Antiformin	2.0 per cent solution	Urine virus not killed in 10 minutes. Killed in 15 min- utes.
Antiformin	1.0 per cent solution	Serum filtrate virus not killed in 24 hours.

<i>Disinfectant</i>	<i>Dilution applied</i>	<i>Result</i>
Antiformin	2.5 per cent solution	Serum filtrate virus killed in 2 hours. Blood virus not killed in two hours.
Milk of lime	Failed to kill in one hour. In other experiments killed in 20 min.
Chlorid of lime	5.0 per cent solution	Serum virus killed in $1\frac{1}{4}$ hours.
Lysol	3.0 per cent solution	Serum filtrate virus usually killed in 1 hour.
Cresol soap solution	3—6 per cent solution	Always killed virus in 1 hour.
Cresol soap solution	3—4 per cent solution	Serum filtrate virus not killed in $\frac{1}{2}$ hour.
Cresol soap solution	3.0 per cent solution	Killed urine virus in $\frac{1}{4}$ hour.

Since a filterable virus has been incriminated as the true cause of hog cholera, various investigators have from time to time attempted to isolate it, stain it, and grow it on artificial culture media. King has made an exceedingly careful study of a spirochæte (*Spirochæta hyos*) which to him has seemed to possess etiological significance, but his

work has never been verified. More recently Proescher and Seil have described a diplococcus which they are inclined to regard as the virus of hog cholera, but as yet they have not submitted substantial proof to justify such a claim. Certain cell inclusions which in cholera-infected hogs appear in the epithelial cells of the conjunctival sac have also been regarded as possible possessors of pathogenic powers, but it now seems probable that these exist as an effect rather than as a cause. There are various organisms which, acting as secondary invaders, exert profound influence on the course of hog cholera and on the lesions which develop, but which should in no way be confused with the filterable virus that produces the disease. These will be considered in another chapter.

CHAPTER III

METHODS OF DISSEMINATION

Hog cholera virus exists only in infected hogs and in material contaminated by their excretions, and this is the fundamental fact to which we must repeatedly refer in accounting for new outbreaks. There are numerous exceptions to the rule, but the individual outbreak can usually be traced to a definite source, and this fact is important in its relation to measures for control.

Shipping infected animals is probably the one practice responsible for most new herd infections. It is not uncommon for a breeder to become discouraged when his hogs begin to die and to ship all seemingly well animals to a distant market. During the fall of the year especially one has but to stand for a few hours at the unloading chutes of some of our large stockyards in order to realize how nearly universal this practice has become. Thus most public stockyards harbor hog cholera virus, and all hogs unloaded in them and later taken to farms for feeding or breeding become potential sources of danger.

In the eastern states garbage feeding is responsible for more outbreaks of hog cholera than

all other factors combined, and in the country as a whole this practice plays an exceedingly important part in the spread of the virus from locality to locality. Many hogs are killed while they are in the incubation period of cholera, and pork that comes from their carcasses, even though it is fit for human food, will produce hog cholera when fed in small portions to hogs. Bits of this infected pork find their way into garbage which is fed to susceptible swine, and the cycle is complete.

The use of hog cholera virus in the field in serum-virus immunization has now become a routine measure, and despite the advantages that result from this practice, it must in truth be said that it is responsible for many new outbreaks of hog cholera. The practice of giving feeding shoats serum-virus treatment and shipping them immediately to distant points operates to infect much new territory, and is often the cause of heavy losses among the hogs thus handled. "Vaccination cholera," as these "breaks" following serum-virus treatment are called, although it usually runs a less rapid course which invites secondary infection, is not fundamentally different from hog cholera contracted as a result of natural infection, but there is a marked tendency in some quarters to avoid the issue and attribute the deaths to causes other than hog cholera virus.

The practice of taking breeding hogs to distant points to mate them is a fruitful source of new herd infections, and in more than one instance we have known the virus to be carried from one farm to another as a result of neighbors exchanging help during butchering time. Small streams to which many hogs have access may also become polluted and carry destruction to herds below the one in which the original infection occurs. Show hogs returned from fairs often contract hog cholera en route or during their contact with other hogs in the show ring, only to infect the herds they represent when they return home.

Besides the regular channels of infection which we have already indicated, and which severally are responsible for most new outbreaks of hog cholera, there are almost an infinite number of casual carriers of the virus, such as crows, sparrows, buzzards, pigeons, and various predatory animals. These, by feeding in infected yards or on carcasses of hogs dead of cholera, may carry the infection to clean territory, but the probabilities are that in most localities the number of herds thus infected is relatively small.

In recent experiments Dr. Marion Dorset has found it difficult to transmit hog cholera from herd to herd by employing attendants, pigeons and sparrows as agents of transmission, and in our own experiments we have failed in a surpris-

ing percentage of cases to infect yards with hogs sick of cholera so that susceptibles placed in them subsequently will contract the disease. In spite of these facts, though, we must in handling hog cholera be guided by the practically universal clinical experience which teaches that when hog cholera once finds its way into a farm herd it will eventually infect all individuals in it, irrespective of the fact that the herd may consist of several pens of hogs kept some distance apart.

It is impossible, and indeed unnecessary, to discuss in detail the various influences which occasionally are instrumental in carrying hog cholera virus from herd to herd, and likewise it is impossible to assign to each influence a relative importance. It is much more important, in concluding this chapter, to call attention again to the fact that in the great majority of cases hog cholera virus travels in certain quite definite channels, and that new outbreaks are usually the direct or indirect result of shipping or moving infected hogs, or else they originate from the practice of garbage feeding, or that of using hog cholera virus indiscriminately in seeking to immunize against the disease.

CHAPTER IV

COMPLICATIONS

BEFORE we consider the symptoms, lesions and diagnosis of hog cholera, it is necessary that we shall discuss briefly some of the organisms that complicate the disease, and which at times exert such profound influence on its course that autopsies become a continual source of surprise and perplexity to the diagnostician. No attempt will be made to give complete morphological and cultural characteristics of these organisms, which information may be found in various standard works on bacteriology. The scope and purpose of this book require that we shall deal only in a general way with most biological characteristics, confining our attention chiefly to disease producing power, especially in swine.

Bact. suisepiticum is the most important of the organisms that complicate hog cholera. It was isolated and described by Loeffler and Schütz in 1885, and in 1886 Dr. Theobald Smith recovered it from various organs of many hogs dead of an epizoötic disease in this country. Moore showed that it is present in the upper air passages of

many healthy swine. In the absence of knowledge of the filterable hog cholera virus, all these investigators were inclined to regard the organism as the cause of epizootic swine plague, and to ascribe repeated failures in causing it to produce transmissible disease, to the fact that field conditions could not be duplicated in the laboratory.

The organism is rod-shaped varying in length from .8 to 2 microns, and in width from .4 to 1.2 microns. Often the ends are rounded giving it an oval shape, but it is not uncommon for the rods to be so short as to resemble micrococci. Sometimes involution forms are observed. In cover-glass preparations made direct from the tissues and stained with basic aniline dyes, *Bact. suis* septicum often stains heavily at the ends and around the periphery, and very lightly or not at all in the center. Preparations made from cultures do not as a rule exhibit this bipolar staining.

The organism is subject to wide variation in virulence. Rabbits, mice and guinea-pigs readily succumb to injections of minute quantities of cultures or suspensions containing it. Rabbits are especially susceptible, usually dying in less than thirty-six hours of an acute bacteremia. Like cultures or suspensions injected subcutaneously into cholera immune pigs produce as a rule a transient local reaction. Small doses injected intravenously may or may not prove fatal, but large intrave-

nous doses produce death from septicemia quite regularly. The pigs that die in less than seventy-two hours may show as lesions congestion of the lymph glands and various parenchymatous organs, or, more rarely, petechial hemorrhages in the kidneys and heart, indistinguishable from those observed in acute hog cholera. In the cases in which the disease runs a less rapid course, there is a rather constant tendency for joint lesions of an inflammatory nature to form, and, contrary to what might be expected, pleuritis and pneumonia appear much less frequently than these joint lesions. Rarely do checks kept with these experimental animals contract disease.¹

The symptoms that appear in pigs artificially infected with large intravenous doses of *Bact. suis* septicum are observed in a very few hours after the injection. There is rapid breathing, sometimes an extreme degree of dyspnea, or the respiratory disturbance may manifest itself in "thumping." The appetite is suspended, the temperature is moderately high (104°-105.5° F.) and there is an anxious facial expression. A general stiffness is practically always observed, and

¹In our own experiments, in which more than 100 pigs were exposed in pens with pigs artificially infected with intravenous injections of *Bact. suis* septicum, 3 contracted disease and 2 died. *Bact. suis* septicum was recovered from the blood and various parenchymatous organs of the dead animals. We know of no other well authenticated instances in which like transmission has occurred.

lachrymation often is pronounced. If death or recovery does not take place in two or three days, the tendency is for the disease to assume a chronic type. One or more of the joints, usually the knee or hock, becomes hot, painful, and swollen, rendering it difficult or impossible for the animal to stand. In spite of this, the temperature falls and is maintained close to normal, the appetite returns and is surprisingly good considering the condition of the animal and the fact that progressive emaciation is taking place. Pneumonia sometimes appears in these chronic cases, adding its train of symptoms, but it fails to develop in a surprising percentage of cases, thus presenting a striking comparison with field outbreaks formerly thought to be caused solely by *Bact. suis* septicum, in which pneumonia is the most constant manifestation. These facts lead us to doubt that the organism, acting alone, is the cause of a rapidly transmissible disease in the field.

Field observations are in almost perfect accord with these experimental data. We have frequently had outbreaks of "pure swine plague" reported to us, and in those we have investigated, in which there was evidence of transmissible disease, we have without exception succeeded in positively demonstrating or establishing the probable presence of the filterable hog cholera virus. It is also significant that in the East, at least, cholera im-

mune hogs do not suffer from "swine plague" if we except the cases in which it is said to appear in the first month subsequent to serum-virus treatment, and which in reality have their origin in the hog cholera virus used.

Acting as a secondary invader in hogs suffering with cholera, in those badly infested with lung worms, and very probably as a primary microbial cause in those weakened as a result of shipping, *Bact. suis* regularly produces a rather characteristic bronchopneumonia, and hastens or causes death. In those cases in which it acts as a secondary invader it produces pneumonia so rapidly and regularly that the lesions due to the primary cause are often obscured or overlooked. Cholera immune farm hogs kept in exceedingly bad sanitary surroundings and exposed regularly to damp and inclement weather, have not been shown to suffer from a rapidly transmissible and fatal pneumonia caused by this organism. There is, though, some experimental evidence that it occasionally produces pleuritis or possibly slight pneumonic lesions from which most hogs recover.

B. suispestifer (*B. cholerae suis*) is another organism which may often be isolated from various parenchymatous organs of hogs dead in outbreaks of cholera. It is a short, motile rod, belonging to the colon group. In 1885 it was described by Salmon and Smith as the cause of epizootic hog

cholera. In later years Uhlenhuth and his co-workers reported finding it in the intestinal tracts of many healthy swine. Jordon, in this country, was unable to identify it in any normal hogs which he examined, and neither was Tenbroeck. Both of these investigators regard Uhlenhuth's work as inconclusive owing to the fact that he did not differentiate correctly between *B. suipestifer* and *B. paratyphoid* B. Smith states that the only distinction that can be made between the two is that the former is pathogenic for rabbits, while the latter is not.

Rabbits and guinea-pigs succumb to small subcutaneous injections of cultures of *B. suipestifer*, rabbits being somewhat more susceptible. Swine are not easily infected with subcutaneous injections, but large intravenous doses prove fatal. According to Welch, small doses may lead to formation of the "button ulcers" observed in chronic hog cholera, and Smith secured like results by feeding pigs bouillon cultures.

The part played by this organism in producing swine disease in the field is not well defined, as most work with it ceased as soon as the filterable virus was accepted as the cause of epizootic hog cholera. There is good evidence that it is one cause of the "button ulcers" just mentioned, and it is likewise probable that, acting in the rôle of secondary invader, it is responsible for the en-

larged, dark, and somewhat pulpy spleens observed in individual hogs dead in outbreaks of cholera. It also seems to intensify hemorrhagic lesions produced by the filterable virus. Its pathogenic powers in relation to cholera immune pigs will bear further investigation, but it is probable that for the most part it acts to complicate diseases produced by other causes.

B. pyocyaneus, or, according to Migula's classification, *Pseudomonas pyocyaneus*, is a motile rod 2 to 6 microns long and .3 to 1 micron broad. It is widely distributed in nature, and there has been a tendency to regard it chiefly as a saprophyte. It is included frequently in the flora of wounds, it appears at times in abscesses in swine and other animals, and it has been described as the cause of an outbreak of dysentery in man. In Germany it is said to be the cause of an infectious nasal catarrh in pigs, and we have found it associated with outbreaks of pneumonia in swine, as the probable cause.

The organism is an aërobe, it grows luxuriantly on the common culture media, tending to overwhelm other bacteria associated with it. It has a marked tendency to produce green color in any culture medium, and the sweetish odor produced by it in bouillon cultures is quite characteristic. It takes the aniline stains regularly, and is Gram negative.

B. pyocyaneus is pathogenic for pigeons, guinea pigs and rabbits. In swine, it is not regularly so, but under certain conditions it assumes great pathogenic significance. We have failed to produce disease by feeding cultures of it or by spraying them into the nostrils of healthy pigs, while subcutaneous doses produced nothing more than an occasional local abscess. Moderate intravenous doses of suspensions containing it cause dyspnea, chilling or spasms to appear immediately, and death, preceded by paralysis, usually of the hind quarters, often takes place in a day or two. This paralysis is observed in rabbits as well, and must be regarded as a more or less constant but nevertheless specific action on the part of the organism. According to Hutyra, cultures of *B. pyocyaneus* inoculated directly into the ethmoid mucosa in young pigs, produce disease similar to the catarrhal rhinitis observed in Germany.

Under natural conditions certain predisposing factors, among which early age, lung worms, hog cholera virus and long confinement in very dusty quarters are most important, prepare the ground so that *B. pyocyaneus* exerts its pathogenic powers. We have observed its effects following hyperimmunization during the process of anti-hog-cholera serum preparation, the hypers developing a fatal pneumonia in a few days following a large intravenous dose of hog cholera virus.

The lesions produced in swine experimentally infected by means of intravenous injections of material containing *B. pyocyaneus* are those characteristic of septicemia, congestion and dark coloration of the lymph glands, lungs, kidneys and other organs appearing regularly. We have observed no such effects where natural infection rules. Here the constant lesion produced is pneumonia, acute or chronic, and the constant symptoms that appear are those that may be referred to this condition.

Dyspnea, abdominal breathing and other marked evidence of respiratory distress characterize the disease. Paroxysms of coughing occur when the hog is required to move, the alæ of the nostrils are drawn backward, giving the snout a peculiar pointed appearance, and it is not uncommon for the affected animals to assume a dog-sitting position, with the forelegs placed widely apart. Thumping appears frequently. Sometimes there is a yellowish purulent discharge from the nostrils. The appetite may or may not be affected, while the temperature, as a rule, remains normal or is only slightly elevated.

The typical lesion which we have found associated with natural infection due to *B. pyocyaneus* consists of a semi-chronic type of bronchopneumonia, affecting first the ventral and cephalic portions of the lungs, or if lung worms are pres-

ent, the posterior border of the diaphragmatic lobe as well. The solidified portions may be red but are often rather light in color, macroscopically resembling the surface of a salivary gland. There is a marked tendency for necrosis to develop from numerous foci, and multiple abscesses occur, appearing as slightly elevated yellow areas dotted over the surface of the pneumonic lung. Pleuritis is somewhat constant, and a high degree of emphysema appears in the dorsal nonpneumonic portion, giving it a pale white color as compared to the normal pink. Often there is distinct evidence that as a final cause of death an acute pneumonia is superimposed over a more chronic type, in which cases all parts of the lungs are pneumonic, while the lesions in the dorsal and posterior portions are of more recent origin.

B. necrophorus is another organism that sometimes complicates hog cholera. Although subject to wide variations in form, it usually appears as a long, slender, nonmotile rod. It is a strict anaërobe, it stains with the ordinary aniline dyes, and is Gram negative. Evidently it is quite widely distributed in nature, for it appears in numerous necrotic lesions in practically all domesticated animals. It is regarded as a normal inhabitant of the intestinal tract in swine, and it exists in soil contaminated with manure. It is the exciting cause of calf diphtheria, lip and leg ulceration in sheep,

and a necrotic stomatitis of calves and pigs, each of which partakes somewhat of the nature of a specific infectious disease, but none of which, with the possible exception of calf diphtheria, tends to be reproduced regularly, in typical form, by artificial means.

In swine, *B. necrophorus* may be the primary, and usually is the exciting cause of various necroses which appear in the mouth, stomach and intestines, nasal passages, skin, and lungs, and are designated, respectively, according to location, necrotic stomatitis, enteritis, rhinitis (bull nose), dermatitis and pulmonary bacillosis. The typical lesion consists of a dark brown necrotic patch which spreads slowly and tends to penetrate the deeper structures. Frequently a yellowish-brown scab or false membrane is formed. In necrotic stomatitis and enteritis especially, numerous lesions often coalesce until large areas are affected, and, depending on location, even the mandible itself may be involved or the intestinal wall penetrated. A foul odor is usually detected. In the mouth, the lesions usually take origin from teething wounds or other slight abrasions; in the stomach and intestines, hog cholera lesions and various irritants prepare the ground for their development; in the nasal passages they follow rhinitis due to other causes; in the skin, they appear especially on the teats and udders of sows

which are chapped or wounded as a result of nursing litters. We know less regarding the primary cause of necrotic lesions that appear in the lungs.

It is still an open question whether *B. necrophorus* is really capable of penetrating normal mucous membrane and producing its characteristic effects, but usually it does not. Likewise there is doubt as to whether it releases a toxin, the probability being that at times it does, for especially in young pigs suffering with necrotic stomatitis, death often takes place suddenly, before it can be explained on the basis of the existing local lesion. On the other hand, some pigs will harbor surprisingly extensive lesions without marked systemic disturbances. Some regard *B. necrophorus* as a secondary invader that may cause the "button ulcers" which appear in chronic hog cholera, but there is at least a distinct difference between the button ulcer in which degenerative and regenerative processes coexist, and the usual lesion produced by *B. necrophorus*, in which a progressive necrosis prevails as long as the exciting cause remains active. There is also somewhat meager evidence that the organism may in rare instances cause petechial hemorrhages in the serous membranes and kidneys.

Bact. suisepiticum, *B. suispestifer*, *B. pyocyaneus*, and *Bact. necrophorus* have two characteris-

tics in common. All are of a subvirulent nature, usually depending on other influences or predisposing causes to enable them to exert their pathogenic powers, and all frequently take advantage of the lesions produced by hog cholera virus, in which they establish themselves, changing the course of the disease, and rendering autopsies puzzling and inconclusive.

There are several other organisms that have been associated with hog cholera, either as complicating influences or probable causes, but some of these normally lead a saprophytic existence, and with our present knowledge we are unable to assign to any one of them a definite pathogenic rôle. *B. coli communis* and other members of the group, together with various streptococci and micrococci may often be found in lungs of hogs that have died of a terminal pneumonia brought on by hog cholera. *Spirochæta hyos* (King) is sometimes found in the blood and intestinal lesions of hogs suffering with cholera, and *B. pyogenes suis* is found in various suppurating lesions in swine, some of which have died in hog cholera outbreaks. The collective primary and secondary effects of all the organisms considered in this chapter, together with the changes produced by hog cholera virus go to make up the symptom-complex which, conveniently but unfortunately, has come to be known as "mixed infection," and

handled as a single entity. Only when we begin to inquire more closely into the disease-producing powers of each organism will real progress be made.

CHAPTER V

SYMPTOMS AND LESIONS

FOLLOWING the subcutaneous injection of a small quantity of hog cholera virus, or the feeding of material containing it, symptoms of the disease usually appear between the fifth and eighth days. In herds through which the disease is spreading, several weeks are often required for it to reach all individuals, but this delay must be regarded as due to failure of some of the hogs to take up the virus, rather than as a prolonged incubation period. The incubation period usually given varies between four and twenty-one days, but in the vast majority of cases symptoms will appear in less than nine days following definite exposure (feeding or inoculation) of susceptible pigs.

Three forms of hog cholera are recognized, peracute, acute and chronic. The peracute form is relatively infrequent, but it occurs occasionally among the first few hogs that succumb in an outbreak. No definite symptoms have been associated with this form of the disease, for the affected animals are found dead with no history of previous sickness.

The acute form, which includes the great majority of cases, begins with high fever (105° – 109° F.), arched back, chilling, rough coat, drooping ears and tail, and general depression. The appetite is impaired. The affected animals may crowd to the trough in the usual greedy fashion, but after drinking sparingly of any liquid that may be contained in the feed, they return languidly to the nest in advance of their associates, slowly draw the litter backward with alternating forefeet, and then settle to sternal recumbency with the snout hidden beneath the litter, seemingly in an effort to keep warm. Intermittent attacks of chilling shake the body, the reflexes are dulled, the eyes closed, and a general stupor prevails.

Conjunctivitis, mild or severe, is practically always present, causing an exudate of a seromucous or seropurulent type to appear, gumming the eyelids together, or forming crusts which remain in the internal canthus and on the margins of the lids.

Early in the attack, constipation is noted. The fecal balls, usually dark in color and often covered with mucus, are voided with difficulty. Later, if death does not ensue, diarrhea sets in, and continues pending the advent of death or convalescence. The character of the food determines the color of the feces.

As the sick hog lies undisturbed in the nest



PLATE 1. Shoats affected with acute hog cholera

there is often noted a scarcely audible, high-pitched, complaining expiratory grunt, but if the animal is seized suddenly it struggles feebly and emits a weak, hoarse squeal. The gait may be unchanged, but often staggering is noticed, and sometimes there is a characteristic unsteadiness or weaving in the hind quarters, best observed in well advanced cases when the animals are caused to move without undue excitement.

Convulsions appear somewhat infrequently, and may be regarded as the only violent hog cholera symptom. The attack usually occurs at feeding time or under stress of other excitement, more often in young pigs. The pig comes to the trough as if to eat, but suddenly backs away, squealing, with the snout drawn low between the forelegs. The muscles stiffen in spasm, the pig falls on its side, the eyeballs roll upward, the legs are in constant motion, and the snout is gradually extended with a jerky, convulsive movement. The attack lasts less than a minute and terminates either in death or complete return of nervous function.

Early in an attack of hog cholera, the skin is flushed, hot and sensitive, the flush being apparent only in clean white pigs. Later, as death approaches, a diffuse purplish discoloration sometimes appears in the skin covering the ears, snout, belly and inner surfaces of the legs, and is less frequently observed at the extremity of the tail,

on the vulva, and in the perineal region. Depending on whether the color results from hyperemia or hemorrhage, it will or will not disappear on pressure. Sometimes congestion and hemorrhage coexist, in which case the color disappears for the most part, revealing the presence of ecchymoses in the pressure-whitened area. Less frequently ecchymoses exist alone. Somewhat infrequently skin ulcers appear on the throat and between the forelegs, very rarely elsewhere on the body. They are light brown, irregularly round or oval in shape, $\frac{1}{2}$ –2 centimeters in diameter, and covered with scabs. A rusty yellow, very sticky exudate, most apparent on the ventral scantily-haired body surfaces, is noted in some individuals.

Cough is observed in many field outbreaks, but it is by no means a constant symptom in uncomplicated hog cholera. We have failed to establish a definite relation between this symptom and the petechial hemorrhages which appear in the laryngeal mucosa. Respiratory symptoms are not prominent in hog cholera unless it is complicated with pneumonia, but dyspnea develops frequently under forced exertion.

The superficial inguinal lymph glands are frequently enlarged so as to attract attention, and another common symptom is the collection of urine in the sheath of the male pig, causing marked distention. When pressed out manually, the urine

has a very offensive odor, and may be cloudy white in appearance, or otherwise abnormal.

As the disease progresses, emaciation is quite rapid, and general weakness prevails. Frequently a terminal pneumonia develops during the last few hours, and death may result from heart or respiratory failure.

Chronic hog cholera occurs, for the most part, among stragglers that survive the acute form, but it may exist independently among semisusceptible young pigs. Emaciation, cough, depraved appetite, diarrhea, unsteady gait, drooping ears and tail, tucked-up flank, and even sloughing of the skin are among the symptoms that appear. Some animals recover, but complete return to normal health is not the rule.

LESIONS

Peracute hog cholera does not usually produce characteristic macroscopic lesions, but congestion of the lymph glands, mesenteric vessels and various parenchymatous organs may often be observed. It is in the acute uncomplicated form that the most typical lesions occur. These consist of congestion, hemorrhages and degeneration, hemorrhages being the only ones which, by virtue of character or location, are highly characteristic of the disease. These appear as petechiæ in the kidneys, serosa of the intestines, mucosæ of the

bladder and larynx, in the pericardium, epicardium, and on the auricles of the heart, especially the left. Exceptionally they are seen in the diaphragm, in the parietal pleura and peritoneum, and subjacent connective tissue. In the lungs, the hemorrhages usually appear beneath the pleura as ecchymoses, more often in the ventral portions of the cephalic and cardiac lobes, but at other times unconfined to particular areas. In the spleen they appear as well-defined slightly raised black areas $\frac{1}{4}$ to $1\frac{1}{2}$ centimeters in diameter, practically always at the edge of the organ and visible beneath its capsule from the dorsal aspect. Some of the lymph glands are practically always congested or hemorrhagic. The hemorrhage appears first around the periphery as the sectioned surface will show, later extending to the trabeculæ, and finally in some cases progressing so far that the entire structure becomes infiltrated, showing on section a uniform dark color. Petechiæ and ecchymoses in the lymph glands are exceptional. The nodes most regularly involved include the gastric, hepatic, lumbar, superficial inguinal, mediastinal and submaxillary.

The hemorrhages which are found in and beneath the alimentary mucosa may appear in the form of petechiæ or ecchymoses, but there is a marked tendency, due probably to constant mechanical irritation, for them to become more

diffuse in character. The pharynx and esophagus are rarely affected, the stomach and small intestines frequently are, while the mucosa of the cecum and upper colon usually is involved.

The skin lesions may consist of congestion or hemorrhage of circumscribed or diffuse nature, the latter type being by far the most common, and appearing as a purplish discoloration usually confined to the ears, belly, snout, inner surfaces of the legs, tip of tail, vulva, and perineal region. Small skin ulcers less than two centimeters in diameter, irregularly round or oval in shape, brown in color and scabbed over, appear somewhat infrequently on the throat, very exceptionally elsewhere on the body. These seemingly take origin from previous hemorrhages.

Some have considered all these changes as due to secondary invasion, holding to the belief that hog cholera virus in itself does not produce macroscopic lesions. To this view we are unable to subscribe, for one may transport filtered virus hundreds of miles, and it will still produce, regularly, some or all of the lesions just described, and it is inconceivable that the same secondary influences should be present in all localities.

In order to place in relief the more characteristic macroscopic lesions which, according to our conception, are due usually to unaided action of the filterable hog cholera virus, we have for the

moment neglected discussion of less characteristic changes which frequently take place. If we consider each organ separately, extending our observations to include less characteristic changes, as well as those produced by secondary invaders discussed in a previous chapter, a more complete picture, and a more accurate interpretation¹ of the pathological anatomy encountered in field cases can be presented.

Mouth and pharynx. Mucosa usually normal. Hog cholera virus may be primary cause of ulcers. These are sometimes present in hog cholera outbreaks, and appear as dark brown necrotic patches on gums, lips, tongue and other parts. Probably due to primary injuries caused by the filterable virus, and certainly caused by *B. necrophorus* as a secondary invader. *B. necrophorus* ulcers occur independent of filterable virus infection.

Stomach. Mucosa frequently normal. Filterable virus causes petechiæ, ecchymoses or larger suffusions in fundus. Congestion due to the same cause usually present. Ulceration relatively rare,

¹ We are fully aware that with our present knowledge such an interpretation can be only approximately correct, but nevertheless there are certain well-defined tendencies which should be indicated. Our conception of the primary filterable virus lesion has been gained, during the last ten years, by performing autopsies on hundreds of pigs which were killed about a week subsequent to injection with virus. The virus was obtained from several sources in various states, some was filtered, some was not. We have also investigated several of the secondary invaders, and the combined results of these investigations with those of similar nature conducted by other workers, are reflected in the remarks which follow.

but necrotic patches due to secondary infection with *Bact. necrophorus* may appear. Serosa usually normal. Exceptionally studded with punctiform hemorrhages, due to filterable virus.

Small intestine. Mucosa sometimes normal. Congestion rather common, also hemorrhages similar to those observed in stomach, and due to filterable virus. Lymphoid nodules often congested, less frequently hemorrhagic, due to filterable virus. Those in ileum most frequently involved. Ulceration rather uncommon, except in extreme posterior portion of ileum. Serosa usually normal. Petechial hemorrhages appear infrequently, mesentery often congested. Changes due to filterable virus.

Cæcum and upper colon. Mucosa most constant seat of digestive canal lesions, especially region of iliocecal valve. Congestion, petechiæ, ecchymoses and larger suffusions common. Strong tendency toward ulceration. Pitlike patches denuded of epithelium. Necrotic ulcers or patches, dark brown in color, sometimes false membrane; ulcers tending to broaden and deepen, little tendency toward regeneration. "Button ulcers"¹ occur in chronic hog cholera. Serosa

¹The ulcers may be isolated and appear as circular, slightly projecting masses stained yellowish or blackish or both in alternate rings, or they may be slightly depressed and somewhat ragged in outline. When the superficial slough is scraped away many ulcers show a grayish or white base. A vertical section reveals a rather firm neoplastic growth, extending usually to the inner mus-

often normal, petechiæ not infrequent. Hemorrhages and destruction of epithelial cells probably due to filterable virus. "Button ulcers" due to *B. suipestifer*, possibly to other organisms. Necrotic patches usually due to *Bact. necrophorus*.

Lower colon and rectum. Usually normal or nearly so. Sometimes congested. Infrequently the lower colon shows the same change as the upper colon.

Larynx. Mucosa frequently normal. Sometimes congested, more often dotted with petechiæ caused by filterable virus.

Trachea and bronchi. Mucosa often normal. Sometimes congested. Probably due to filterable virus.

Lungs. Very often normal. Primary lesions sometimes caused by filterable virus consist of ecchymoses visible beneath the pleura. These appear most frequently on the cephalic and cardiac lobes, but are not confined to these parts.

Terminal pneumonia due to filterable virus plus nonspecific secondary invaders. Often affects all cular coat. When sections of such an ulcer are stained with aniline dyes and examined under the microscope, the submucous tissue is very much thickened, infiltrated with round cells and containing a large number of dilated blood vessels. Resting upon this thickened submucosa, is a line of very deeply stained amorphous matter, and upon this is situated the necrotic mass which fails to retain the coloring matter and which is permeated by a very large number of bacteria of various kinds. Frequently the eggs of trichocephalus are imbedded in the slough."—Moore, *Pathology of Infectious Diseases*.

lung tissue. Lung solidified, red. Pneumonia of recent origin.

Swine plague pneumonia due to filterable virus

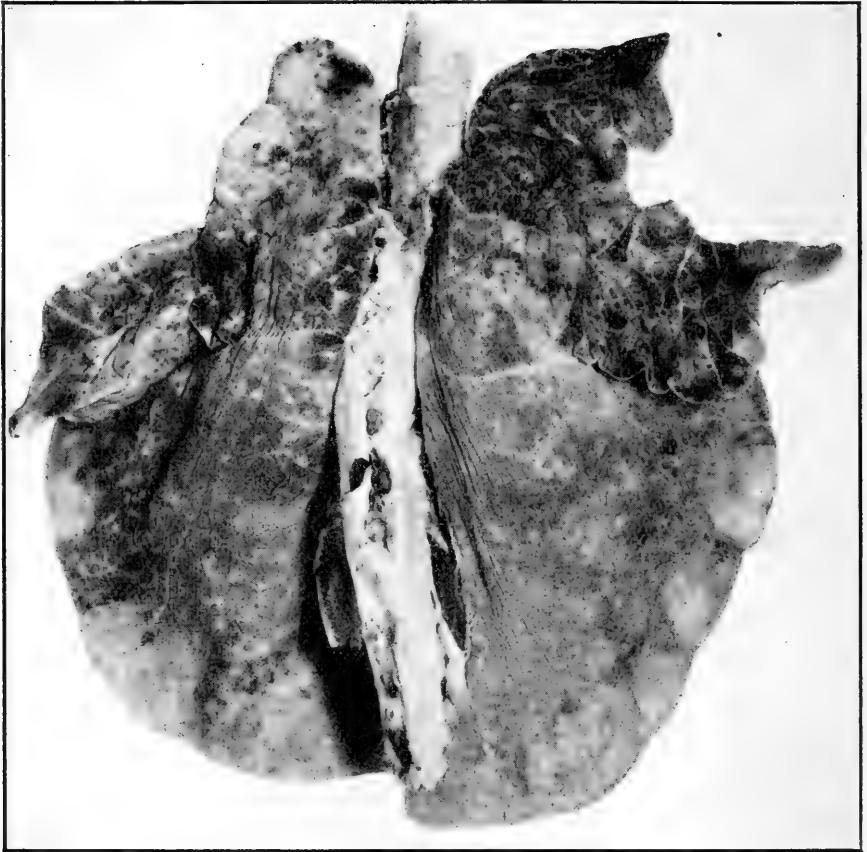


PLATE 2. Lung of pig showing ecchymoses due to acute hog cholera. These appear in greater numbers on the apical and cardiac lobes

plus *Bact. suis* *septicum*. Cephalic and cardiac lobes first to be affected, later other parts may solidify. Solidified portion usually red or reddish gray. Usually bronchopneumonia. Interlobular

spaces well defined macroscopically, due to infiltration of leucocytes or blood. Tendency toward necrotic and caseous masses in cases of longer standing. Pleuritis constant. Pleuræ often thickened, rough, white, adherent.

Pneumonia, characterized by necroses which start from various foci, tending to involve all structures alike, sometimes spreading to the heart by contiguity. Filterable virus plus *Bact. necrophorus*.

Pneumonia, often semichronic, tending toward formation of multiple abscesses visible beneath the pleura, as slightly raised, yellow areas. Visible on section in deeper parts. Pneumonic lung may be red. More often grayish in color. Due to filterable virus plus *B. pyocyaneus*.¹

Heart. Usually normal. Filterable virus lesions consist of petechiæ and ecchymoses which are visible on the surfaces of the auricles, usually the left. Sometimes congestion of coronary vessels. Heart itself rarely the seat of secondary lesions. Epicarditis and pericarditis often result from secondary infection with *Bact. suisepiticum*.

Spleen. Sometimes normal or slightly enlarged. Very small bright-red protruding hem-

¹Hog cholera virus is only one of several influences capable of producing primary changes which, in the presence of secondary invasion with either *Bact. necrophorus* or *B. pyocyaneus* may result in the lung lesions mentioned in connection with these organisms. For instance, we regard lung worms in combination with *B. pyocyaneus* as a frequent cause of pneumonia in pigs.



PLATE 3. Left auricle of pig's heart showing petechiae due to acute hog cholera



PLATE 4. Spleens showing hemorrhages which are rather typical of acute hog cholera. These hemorrhages are observed in only a small percentage of cases

orrhages beneath capsule are normal. These are frequently on ventral surface near the hilus, not so often along the borders and on the dorsal surface. Characteristic filterable virus lesions consist of black, well defined slightly raised hemorrhages $\frac{1}{4}$ to 2 centimeters in diameter, located practically always somewhere on the margin. Spleen may be enlarged, dark, friable, engorged with blood. Due usually to secondary invasion with *B. suispestifer*, sometimes to other causes. Not of much diagnostic value as related to hog cholera.

Liver. Macroscopic appearance usually normal. Very exceptionally ecchymoses, seemingly due to hog cholera virus, are visible beneath the capsule. Often shows degenerative changes, probably due to hog cholera virus, but by no means characteristic, as they may be due to a variety of causes.

Kidney. Very rarely normal. Seat of the most characteristic and constant hog cholera lesions, consisting of petechiæ. Organ may be changed as follows:

Normal in color, capsule peels easily. Surface of kidney studded with petechiæ which appear beneath the capsule, involving the glomeruli as well as other parts. On section, the petechiæ are seen variously distributed in the cortex, in the medulla, and sometimes in the membrane of the



PLATE 5. Kidney of pig showing numerous petechiæ due to acute hog cholera. Often these petechiæ are so small and few in number that it is necessary to examine the kidney very closely in a good light in order to observe them. The capsule is removed in order to make them more plainly visible

renal pelvis. They are due to the filterable virus.

Engorged with blood. Capsule peels easily. Petechiæ distributed as already described. Tendency toward more and larger hemorrhages. Changes usually due to filterable virus. *Bact. suis* or *B. cholera suis* may be secondary invaders.

Very light in color, "cooked kidney." Capsule peels easily. Marked evidences of degeneration. (Cloudy swelling and granular degeneration.) Petechiæ distributed as already described. All changes probably due to filterable virus.

Very light in color. Capsule peels easily. No petechiæ. Seen most frequently in chronic hog cholera. Changes often due to filterable virus, but not characteristic of it.

Very light in color. Capsule peels with difficulty, may be thickened. Evidences of degeneration followed by increase in interstitial tissue, and chronic nephritis. Primary degeneration probably due to filterable virus. Nephritis due to secondary causes. All of these changes of little diagnostic significance.

Considered in general, these petechial hemorrhages in the kidney are rarely due to influences other than hog cholera virus. Exceptionally they may be due to *Bact. suis*, acting either as

a primary or secondary influence. There is a tendency by no means constant, and of little diagnostic significance, for larger and less well defined hemorrhages to appear under the influence of *Bact. suisepiticum*. There is also some evidence, as yet poorly substantiated, that very exceptionally *Bact. necrophorus* produces petechiæ in the kidneys of hogs. This should be regarded as a remote possibility occurring only in association with extensive necrotic lesions in other organs.

Bladder. Sometimes normal. Mucosa slightly congested, due to hog cholera virus or other causes. Mucosa dotted with petechiæ, due usually to hog cholera virus.

Sheath. Often normal. Sometimes distended with foul smelling, discolored urine. Catarrhal inflammation of mucosa. Condition not characteristic of hog cholera. Found in other diseases, especially those resembling rheumatism.

Lymph glands. Sometimes normal. Typical filterable virus lesion consists of congestion or hemorrhage which appears first in the cortex of the gland, and which may later involve the entire structure giving it a uniform dark color on section. Petechiæ are rarely present. Edema frequently pronounced. Permanent enlargement and caseation occur in chronic hog cholera. Rare for all glands to show macroscopic changes. Glands

most frequently affected are the gastrics, hepatics, superficial inguinals, lumbar, submaxillaries and mediastinals.

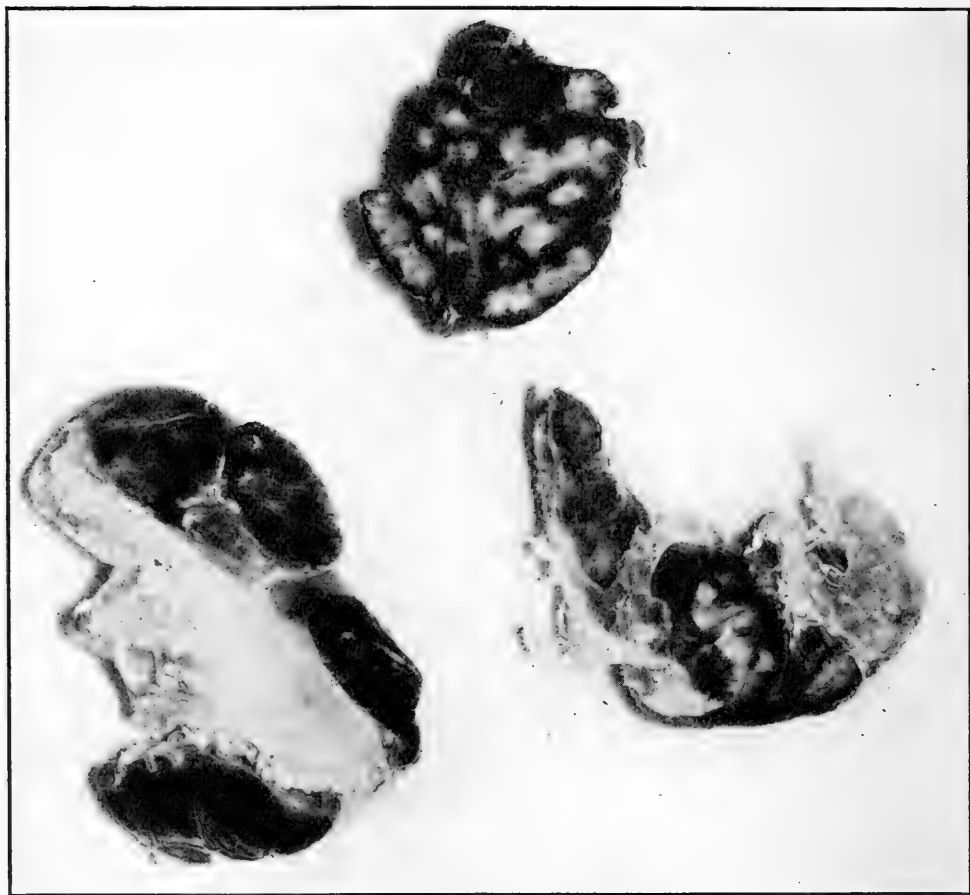


PLATE 6. Lymph glands of pig showing hemorrhages caused by acute hog cholera. Left, darkened surfaces of glands. Above, sectioned surface showing hemorrhages around the periphery and in the sinuses. Right, darkened gland with small section cut away to show peripheral hemorrhages

Skin. Often normal. Typical filterable virus lesions consist of purplish discoloration, representing marked congestion or diffuse hemor-

rhage. Ecchymoses more rarely visible. Ulcers, apparently originating in these ecchymoses sometimes occur on throat and between forelegs. (In hot weather purple discoloration appears a few hours after death in hogs, especially fat ones, dead from *any* cause.)

The pathology and microscopic tissue changes produced by hog cholera virus are not well worked out, but nevertheless the relation between primary filterable virus lesions and secondary changes due to other causes is fairly well understood. Let us consider, for instance, lesions of the digestive mucosa. Congestion appears first. It will disappear or terminate in hemorrhage. Following hemorrhage, regenerative or degenerative processes will occur. The degenerative processes may result in destruction and excoriation of the epithelial cells, leaving an unprotected surface in contact with the intestinal contents. Individual resistance and the bacterial flora of the intestine will determine future developments. Regeneration will rule, or secondary infection will take place. If *Bact. necrophorus* is present in sufficient numbers, necrotic enteritis will be produced. If *B. suispestifer* exists in overpowering numbers, the familiar "button ulcer" may develop.

In the intestine, we find the primary lesions due to the filterable virus most frequently in the cæ-

cum and upper colon, and as would be expected, we find the secondary lesions distributed in precisely the same manner. If we examine a hog dead of cholera after a short sickness we encounter intestinal lesions in which congestion, hemorrhages and early evidences of degeneration predominate. In hogs that have been sick longer, autopsies often reveal a surprising variety of lesions which collectively encompass effects of the struggle between degenerative and regenerative forces, and which reach their most typical form in the "button ulcer."

In considering thoracic lesions, the same general principles apply. If we inject a pig with filtered hog cholera virus, and kill it about seven days later, the lungs, if affected, will show petechiæ and ecchymoses, most likely appearing on the cephalic and cardiac lobes, but not always confined to these parts. There may also be congestion of the mucosa of the air passages. Both changes are due to the filterable virus. What result would we expect if a secondary invader, capable of producing inflammatory changes, should find its way into lesions thus prepared? Obviously we would expect to find bronchopneumonia, occurring most regularly in the cephalic and cardiac lobes but not always thus limited. It is significant that this is the exact picture presented when secondary infection with *Bact. suisepiticum* takes place.

The urine of hogs suffering with cholera often contains albumin in excessive amounts, and the chlorids frequently are diminished in quantity, or present only in traces. Contrary to what might be expected, blood and hemoglobin are absent, almost without exception.

CHAPTER VI

DIAGNOSIS, DIFFERENTIAL DIAGNOSIS, PROGNOSIS

EARLY and correct diagnosis of hog cholera is essential in coping with the disease effectively. Often an entire herd is in jeopardy, and if hog cholera is present prompt preventive measures must be taken to save it. The diagnosis involves no great difficulties when many hogs are sick, but in the early days of an outbreak when peracute or otherwise atypical cases are likely to occur, puzzling situations arise which sometimes cause costly delay. Thus in exceptional cases we are justified in making a provisional diagnosis of hog cholera, and in handling the herd in exactly the same manner as we would were a positive diagnosis possible. Experience has taught that we should not be too conservative in regard to taking such a course when the history suggests the disease and when valuable animals are at stake.

In seeking to determine the presence of hog cholera we depend on four considerations:

1. **History of the outbreak.**
2. **Symptoms.**
3. **Lesions.**

4. **Animal Inoculation** (rarely applicable).

History. Securing the history of an outbreak of suspected hog cholera is simply applying knowledge of the ways in which the virus spreads. Usually we find that a hog has died of an unknown cause and a few days later sickness has appeared among its associates. Careful inquiry should be made regarding recent introduction of hogs into the herd, existence of swine disease in the vicinity, adjacent arteries of traffic and source of feed and water supply. Stockyard hogs and others introduced without clear history of previous health should remain under suspicion. Even though they do not themselves contract the disease they may act as intermediate carriers. There is no evidence that hog cholera virus travels through the air but a road or railroad right-of-way may be contaminated by the drip from infected wagons or cars. If the herd is subsisting on garbage and is not immune the circumstances suggest hog cholera. If kitchen swill is being fed inquiry should be made as to whether the kitchen is supplied with market pork.¹

In general the facts brought out by the history of an outbreak simply constitute supplementary

¹ In one instance that came under our observation an outbreak of hog cholera was traced to meat trimmings that were placed in a poultry house. Two small pigs formed the habit of escaping from the pen and eating freely of these trimmings. Both developed hog cholera simultaneously, and later transmitted it to their associates.

evidence tending either to affirm or deny the presence of hog cholera. Unless there is a definite history of direct exposure the history in itself is not conclusive.

Symptoms. Unless several animals are sick it is seldom possible to make a positive diagnosis based on symptoms alone, but the experienced observer is usually fairly certain of his ground. It is essential to remember that early in an outbreak we do not observe the greatly emaciated hog with arched back, straight tail and drooping ears which has been so frequently described and photographed, and which is the product of long sickness. It should also be kept in mind that many of the symptoms observed in acute hog cholera are present in other diseases, and that all of the symptoms that characterize the disease, do not often appear in one animal. Special consideration must be given to a restricted number of the more characteristic symptoms.

In examining a herd for suspected hog cholera one should first see it unaffected by artificial excitement, taking care to observe a tendency in individuals to chill and crawl beneath the litter. Then the animals may be tempted from the nest with feed, observation being made for any that are reluctant to move, or that stagger or weave in the hind quarters. The animals that come greedily to the trough but leave for the nest in advance of

their associates, dropping slowly to sternal recumbency with their snouts half buried in the litter should be regarded as probable cases of hog cholera, especially when intermittent attacks of chilling are observed.

Temperature is an important guide, but great care must be taken in securing and interpreting readings. Normal temperatures of hogs vary between 101° and 104° F. and independent of disease, excitement or exertion causes a more rapid temperature elevation in swine than in other animals. Docile adult breeding animals in medium flesh are inclined to show readings near 101° F., while those of young pigs and fat hogs tend to approach 104° F. In taking temperatures of pigs, the thermometer, preferably one with pear or globe-shaped bulb and at least five inches long, should be inserted almost full length. Otherwise many inaccuracies (readings too low) will occur, because a pig, especially if held by the hind legs, will often relax the rectum as long as the thermometer remains in position. Chasing pigs to catch them often elevates their temperatures rapidly, and should be avoided.

It is important to keep in mind the usual hog cholera temperature curve. In the typical case of the acute form of the disease the curve rises rapidly at the onset of the attack and reaches an elevation between 106° and 107° F. in less than

forty-eight hours. This level is maintained for about four days and is followed by a sharp decline which may bring it near normal for a few hours. Then there is an upward trend which carries it near the former high level in which position it may be maintained, or it may fluctuate somewhat violently from day to day. Sometimes it remains elevated until death takes place, but usually it sinks below normal a short time before the pig dies.

Thus it is always well to secure temperatures of hogs recently affected, and to be cautious in regard to making a negative diagnosis on the strength of a limited number of temperatures near normal. Several readings near or above 106° F., supported by other suspicious symptoms and a history that indicates hog cholera, may rightly form the basis for a provisional diagnosis. On the other hand, a considerable number of temperatures below 104° F. in sick hogs, strongly suggests some other disease. Between these extremes the readings are less conclusive.

In this country, and in others where swine erysipelas is not prevalent, the characteristic diffuse purplish discoloration which appears on the belly, ears and snout is pathognomonic of hog cholera, but it is observed in relatively few cases. If this discoloration is not observed before death it is of no significance, for it may occur as a post-mor-

tem change in swine dead from any cause, especially fat hogs that have died in hot weather.

Other less characteristic symptoms add evidence, but most of them may result from causes other than hog cholera, and it is unsafe to give them too much weight in their relation to diagnosis.

Lesions. Lesions constitute our most accurate guide in diagnosing hog cholera, for it is not often that a conclusion can be reached without considering them. Hogs sometimes die of the disease without showing any characteristic macroscopic tissue changes, so if no cause for death is found, additional autopsies should be performed. In case it is necessary to kill a pig for this purpose, it is best to select one that has been sick several days, but not a chronic case. Petechiæ and ecchymoses are the chief changes which characterize hog cholera, but it is important to remember that in cases of long standing, and in those in which secondary invasion has taken place these primary filterable virus lesions may be so changed in character that they are difficult to identify.

Assuming that we have before us a carcass, and that hog cholera is suspected, the autopsy will include special examination of the skin, kidneys, bladder, lymph glands, spleen, heart, lungs and laryngeal mucosa, as well as the serous membranes readily accessible, and the digestive tract. The

changes which appear in these various parts have already been discussed, so for our present purpose we will consider chiefly those which are of primary importance in their relation to diagnosis.

The skin is examined for ecchymoses and yellowish-brown ulcers which sometimes appear on the throat and other ventral surfaces. If there is a purplish discoloration, inquiry should be made as to whether it was noticed before death took place. An affirmative reply suggests hog cholera, while a negative one practically dismisses the lesion from consideration. Changes in the skin are frequently absent.

As we open the thoracic and abdominal cavities petechiæ and ecchymoses are sometimes observed in or immediately beneath the serous surfaces thus exposed. They appear infrequently in the parietal pleura and parietal peritoneum and are somewhat more common in the serous coat of the intestine, especially that of the cecum and colon.

The kidney lesions are highly characteristic of hog cholera, and they occur in nearly all cases. They consist of petechiæ which are distributed on the surface, as well as in the deeper structures. These are dark red in color and sharply defined, often giving the organ the "turkey egg" appearance. Sometimes they are so few in number that the capsule must be removed in order to see them,

care being taken to make the examination in a strong light. Infrequently other causes produce petechiæ in the kidneys of swine, but in this country, unless another cause is apparent, either by virtue of the history or accessory lesions, we are safe in attributing them to hog cholera.

Petechiæ in the mucosa of the bladder occur in most cases of hog cholera, and they do not often result from other causes. The serous surface is practically always normal.

Some of the lymph glands are usually involved, and to the experienced observer the changes in them aid greatly in making a diagnosis. On the surface the gland is very dark red, almost black. On section the periphery is similar in color, while the deeper structures may remain unchanged. It is important to bear in mind that any inflammatory process may affect adjacent lymph nodes, and to make allowance for this fact, but marked peripheral congestion or hemorrhage, when observed in several glands widely separated, in the absence of apparent inflammation in adjacent structures, strongly indicates hog cholera.

The spleen reveals characteristic hog cholera lesions only in the dark, swollen circumscribed hemorrhages, usually less than 1 centimeter in diameter, which appear along the border. In field cases that have died of hog cholera these lesions are not often observed, because secondary invad-

ers have so enlarged and darkened the entire organ as to render them invisible, and because post-mortem changes take place rapidly. The enlarged, dark, pulpy spleen which is often encountered in hog cholera outbreaks is of little significance in diagnosis, because it is so frequently the result of other causes.

The heart reveals no macroscopic lesions in the vast majority of cases, but the petechiæ which are sometimes visible on the left auricle, less frequently on the right, and rarely involve the ventricles, are usually caused by hog cholera virus.

The lungs are often normal. If the surfaces are dotted with ecchymoses, the fact suggests hog cholera quite strongly, but occasionally these lesions are due to other causes.

The laryngeal mucosa is often the seat of petechiæ, which are characteristic of hog cholera.

Examination of the intestinal mucosa often aids in making a diagnosis, but the lesions encountered are often difficult to interpret. Certain irritants cause changes which may be confused with those due to hog cholera, and secondary invasion tends rapidly to modify filterable virus lesions so that they are difficult to identify. Ecchymoses and larger hemorrhages, as well as ulcers of recent origin, when distributed near the ileocecal valve and elsewhere in the mucosa of the cæcum and upper colon, may be accepted as supplementary

evidence of acute hog cholera. The "button ulcer" is usually associated with the chronic form, but agents other than the filterable virus may be instrumental in producing it.

All these hog cholera lesions will not often be found in one animal, but if two or more organs are involved this fact, supported by a history that does not positively deny the presence of the disease, may be accepted as ground for a diagnosis. If more organs are involved the evidence is more conclusive.

Animal inoculation. This method is rarely applicable in actual practice, because it is expensive and requires too much time. In very exceptional outbreaks which present atypical features, and in cases involving litigation it may be useful. The essentials of a conclusive experiment may be summarized thus:

1. Blood should be drawn from a hog which has been sick for only a short time, and which carries a temperature near 106° F.

2. The blood should be diluted with sterile water and passed through a filter which retains all microscopic organisms.

3. Enough of the filtrate to represent at least 1 mil of the undiluted blood should be injected into a susceptible pig, preferably one weighing between forty and one hundred pounds.

4. Twelve days previous and subsequent to the

date of injection the pig should be protected from extraneous hog cholera infection; all receptacles and instruments used in making the injections should be sterilized.

5. Symptoms of hog cholera should appear in less than eight days following the injection.

6. The pig should die in less than seven days following the appearance of symptoms, or at the end of that time, providing it is still sick, it should be killed.

7. Autopsy should reveal typical hog cholera lesions in at least two organs.

8. In negative experiments the susceptibility of the experimental pig should be proved by a subsequent injection with at least 1 mil of virulent hog cholera blood.

Differential Diagnosis

Peculiar difficulties are met in the differential diagnosis. Clinical examination of the individual is subject to limitations which are not encountered in dealing with larger animals, and some of the maladies which we seek to differentiate from hog cholera occur so frequently *in combination with that disease* that we do not always have well defined features upon which to base our conclusions. Thus under certain circumstances we have not only to decide whether a given outbreak is hog cholera or swine plague, but we must also

ask ourselves whether the two diseases exist in combination. Laboratory examinations may demonstrate the presence of a bipolar organism, but they cannot in the course of a few hours deny the presence of the hog cholera virus, and thus they are often dangerously misleading. Return mail diagnoses of "swine plague" or "hemorrhagic septicemia" are without value because they ignore consideration of hog cholera virus, which in this country is present in most outbreaks of rapidly transmissible swine disease.

Among the diseases from which hog cholera must be differentiated are uncomplicated swine plague, pneumonias due to a variety of causes, septicemias, tuberculosis, anthrax, so-called "flu," various parasitisms, soap poisoning, brine poisoning, and sudden deaths from such causes as heat-stroke and lightning-stroke. Rouget and rinderpest are also to be considered in countries in which they are prevalent.

The differential diagnosis cannot be made by rule of thumb, nor is it possible to summarize or tabulate the determining features of these various maladies, so that the inexperienced observer can distinguish among them. Armed with definite knowledge of the diseases with which he is dealing the diagnostician usually reaches his conclusions rapidly and accurately. In the absence of such knowledge, a few rules do not suffice.

Having already dealt with the distinguishing features of hog cholera we will confine our remarks chiefly to characteristics which suggest the presence of these other diseases.

Swine plague. Swine plague rarely occurs in pure form, it affects only a portion of the animals in a herd, and there are frequent spontaneous recoveries. There is often a history of recent shipping. The incubation period is short (1 to 3 days), acute dyspnea and thumping are prominent symptoms, and the hogs show more distress than is observed in hog cholera attacks. High temperatures are not the rule except during the first few hours of sickness. The characteristic "swine plague pneumonia," if present in several autopsies, speaks for the existence of swine plague, but the absence of the filterable hog cholera virus must be clearly established before a diagnosis of pure swine plague is justified.

None of the pneumonias, with the exception of that associated with swine plague, are accompanied by the lesions in other organs which characterize hog cholera. Usually they occur where pigs are kept in very dusty quarters, or where the floors are cold and damp and no dry litter is provided. Recent shipping is a predisposing factor, and lung worm and ascarid infestations play an important part in their development. They are sporadic or only slowly transmissible. High

temperatures are not common, and the prominent symptoms grow out of the pneumonia itself.

Exceptionally septicemia due to nonspecific organisms may occur, but its features are not well defined. In differentiating we must therefore depend on the more definite manifestations of hog cholera.

Tuberculosis may only rarely be confused with chronic hog cholera. Hogs following tuberculous cattle and those fed infected creamery by-products are most commonly affected. The history of the case should be considered and if doubt remains the intradermal tuberculin test may be applied. If material for autopsies is available, the differentiation presents no great difficulties.

Anthrax and the peracute form of hog cholera are not always easy to differentiate. If the former disease has existed previously in the locality; if other classes of live stock are affected; if the hogs show swelling of the throat or froth mixed with blood coming from the mouth or nostrils; if the blood is black and incoagulable, anthrax should be suspected, and a microscopical examination made.

A malady known as "state fair disease" or "flu" has in recent years been recognized in the central states. It is often associated with a history of recent shipping, respiratory symptoms and lesions predominate, and recovery is the rule.

This latter fact alone will distinguish it from hog cholera, when it occurs in pure form.

Ascaris infestation and hog cholera sometimes exist in the same herd. As a result of the diarrhea incident to the latter disease ascarids are frequently evacuated in the feces, and the entire train of symptoms, as well as the deaths, is attributed to the parasites alone. Even though the parasites are present in large numbers, if deaths are numerous, further examination should be made for evidence of hog cholera.

Lung worms cause cough, emaciation and other symptoms which resemble those observed in chronic hog cholera. The history of the outbreak, supplemented if necessary by an autopsy, will be sufficient to determine its cause. Chronic hog cholera is usually a sequel of the acute form. Lung worms are often associated with pneumonia, causing death most frequently in young pigs. Unless great care is used these parasites may be overlooked. The smaller air passages should be laid open with sharp shears and the examination made in a strong light.

Considered collectively, the various drug and food poisonings differ from hog cholera in that several animals often are affected at the same time, the symptoms as a rule are more violent, vomiting is more common, and temperatures are not so high. The history may reveal the source

of the particular poison, and some of the drug poisonings (strychnin, belladonna, lead) are in themselves characteristic. Poisoning with the alkaloids produces no lesions, and no poison, so far as we know, is responsible for changes which are observed in hog cholera. Common salt (sodium chlorid) is especially poisonous for hogs that are not accustomed to it, causing intense inflammatory changes in the digestive mucosa, and congestion of the meninges. Long continued feeding with material containing soap and lye will produce disease resembling chronic hog cholera. However, our task is usually to differentiate between poisonings and acute hog cholera, and this presents no great difficulties if we resort to autopsies, for none of the poisons produce lesions which resemble those observed in acute hog cholera.

In suspected heat-stroke and lightning-stroke, the history is an important guide. Heat-stroke occurs most frequently in fat hogs deprived of shade or water in hot weather, and in those shipped in overcrowded stock cars, or subjected to excitement or violent exertion during the summer months. The hair of hogs dead of lightning-stroke may be seared, there may be arborescent congestion or hemorrhage in and beneath the skin at the point where the current entered the body, and sometimes there are lacerations of the internal organs. Rigor mortis is not pronounced.

Rouget or swine erysipelas does not exist in the United States. The septicemic form of the disease resembles hog cholera very closely. It has a shorter incubation period than the latter disease, but resort must often be made to microscopical examination, in order to distinguish between them.

Rinderpest does not occur in the United States, and in countries in which it is prevalent, swine do not contract it readily. For this reason it is not well characterized, but in case of necessity it may be distinguished from hog cholera by filtration experiments in which cattle are used as test animals. Both viruses are filterable, but that of rinderpest is the only one of the two which affects bovines.

Prognosis

In the individual, hog cholera runs a rapid and fatal course, and even when recoveries occur, they may be slow and incomplete. Therefore in all hogs visibly sick the prognosis is bad, but it is the herd as a unit which we must consider, for we are frequently called on to estimate the salvage which may be expected. The ability to do this with a reasonable degree of accuracy is acquired only by experience, and it is a great asset to one who handles hog cholera in the field. We can indicate only the guiding principles upon which the prognosis depends.

The number of animals dead and visibly sick at the time of serum treatment forms our chief basis of estimate. Assuming that a herd is kept under average farm conditions, and that there is no evidence of complications, as a very general rule we expect to save about as many hogs as are eating greedily and are free from abnormal temperatures on the date of serum administration. Some of those that show no fever will die, and a few of those that show fever will recover, one class approximately compensating the other.

In herds in which it is not possible to secure reliable temperature readings, the prognosis must be more guarded. In general, during the early days of an outbreak, we expect about as many deaths to follow serum treatment as the combined sum of the hogs that have previously died and those visibly sick when serum is administered. If fifty per cent of the animals in a herd are dead or visibly sick we expect the salvage to offset the cost of serum treatment, and leave something to spare, but we cannot promise much in such a herd.

Evidence of secondary infection, coexisting parasitisms, improper feeding and housing, a history of recent shipping or other weakening influences all call for a guarded prognosis. If the hogs have not been confined closely, or if they are in several pens some of which remain uninfected, the prognosis is relatively more favorable.

CHAPTER VII

PREPARATION OF ANTI-HOG-CHOLERA SERUM AND HOG CHOLERA VIRUS

WE are indebted to Dr. Marion Dorset and Dr. W. B. Niles of the United States Bureau of Animal Industry for developing our present method of preparing anti-hog-cholera serum. The discovery that hog cholera is caused by a filterable virus dismissed further efforts to immunize against it with products of various bacteria, but it suggested hope for a protective serum analogous to that used against rinderpest, a filterable virus disease of cattle. That hope was realized in 1908 when Dorset announced his discovery, and although the immediate control of hog cholera which some predicted did not materialize, the obstacles encountered have not been due to any fundamental defect in the serum itself. When properly prepared and used it is one of the most effective biologics known to preventive medicine.

Anti-hog-cholera serum production is highly organized and carefully controlled in the United States and many laboratories are in operation which are models for convenience, cleanliness and

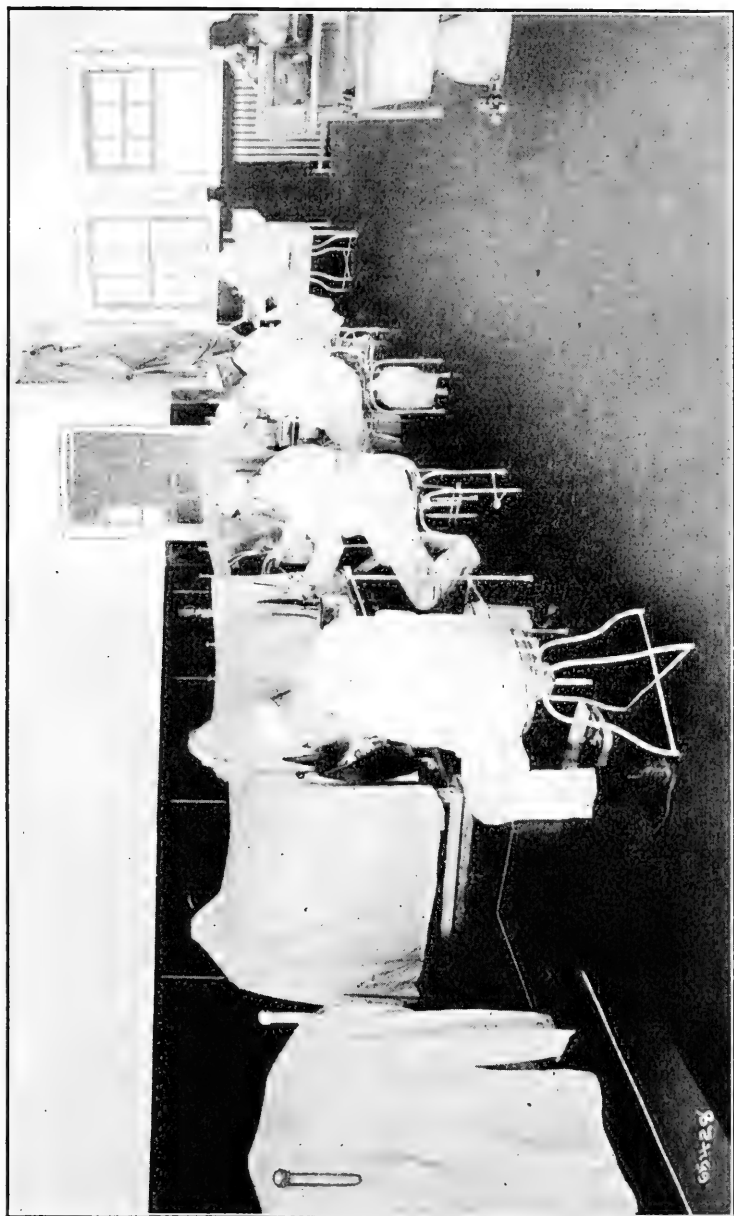


PLATE 7. Bleeding room in anti-hog-cholera serum laboratory. (Courtesy Pitman-Moore Biological Laboratories)

sanitation. All laboratories which make interstate shipments must secure licenses from the federal government and submit to regulations which have been formulated to protect those who use the products. The laboratories must meet certain well-defined requirements before they are allowed to operate, and thus despite great deviation in detail, the same fundamental processes are used in all of them. We will consider first the essential requirements for preparing the protective defibrinated blood, which has been called anti-hog-cholera serum, and which forms the basis of all the more or less refined products used to prevent hog cholera in the field.

Buildings. The buildings should be suited to the conditions under which the laboratory is to operate. These conditions vary so widely that uniformity is neither to be expected nor desired, but certain governing principles should be observed in all construction. In general, simplicity, convenience in operation, and provisions for cleanliness are the primary considerations. Future upkeep costs should also be reduced to a minimum in the original construction. Under most conditions concrete is the best material to use.

The walls, ceiling and floors should be finished so that water will not injure them. The floors should be drained in a sanitary manner. Steam or hot water heat should be provided, the

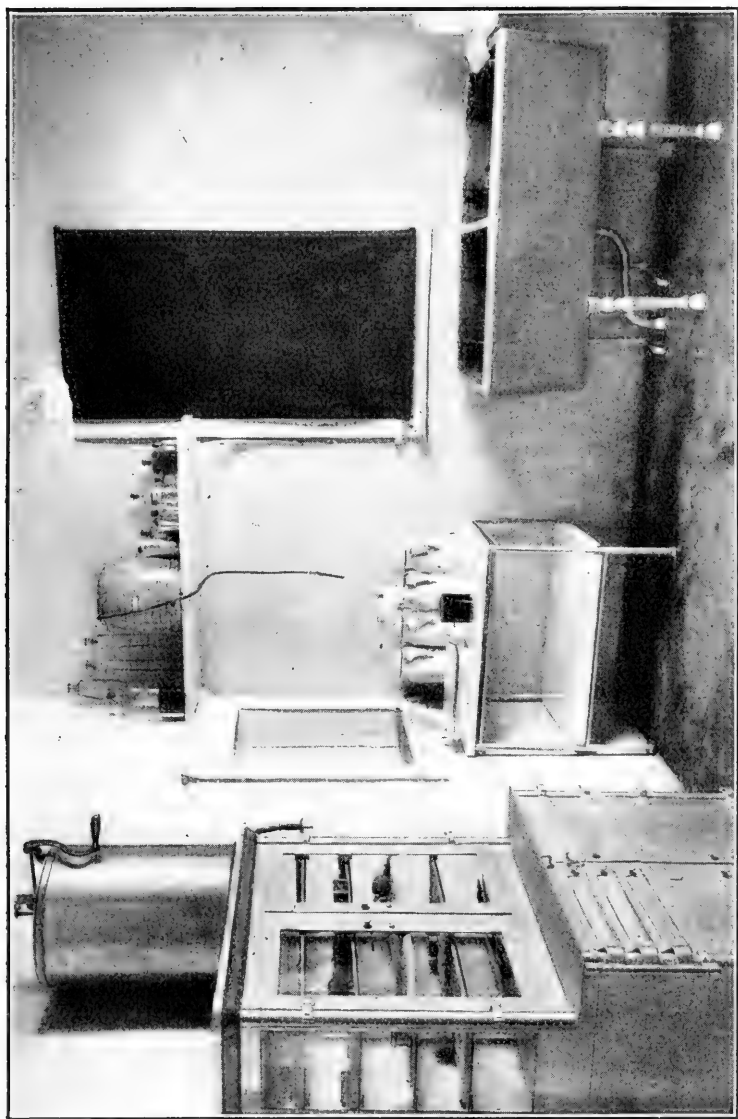


PLATE 8. Corner of anti-hog-cholera serum laboratory. New York State Veterinary College at Cornell University

building should be plumbed for hot and cold water, and all outside doors should be screened in summer. Ample light and ventilation are required.

The minimum requirements for reasonable convenience and cleanliness in a serum laboratory consist of preparation room, bleeding room, serum laboratory proper, office, dressing room and lavatories, store room and refrigerator room, as well as furnace room and coal bins so situated that dust from them will not contaminate other parts of the building.

Quarters for the hogs should be suited to local requirements. In any event they should be at least seventy-five feet from the laboratory building, and even a greater distance is desirable. The floors should be of concrete, well drained, and ample light and ventilation should be provided. Room for exercise on the ground is desirable, and pasture for hogs that are to be kept for several weeks is a great asset. Provision should be made for sanitary disposal of manure, and other waste from the laboratory and hog quarters. In general, convenience for those who care for the animals, and cleanliness and comfort for the animals themselves are the chief considerations.

The equipment of the laboratory is likewise governed by individual needs. Too much equip-

ment is a detriment, as methods are constantly changing and improving and each unnecessary fixture takes up room and must be kept clean. Essential major equipment includes facilities for washing, sterilizing and storing all instruments and containers used, vacuum and pressure tanks connected with motor driven pumps, portable crates for tail bleeding and hypering, portable or stationary tables or stocks for bleeding serum hogs and virus pigs from the throat, scales, motor driven shaker, serum mixer and office equipment including forms for keeping records.

Minor equipment includes bleeding and hypering units, tail shears, clamps, hypodermic syringes and needles, wax heater, cannulas and sticking knives, scalpels, instrument trays, antiseptic containers, funnels, graduates, pipettes, defibrinating forks, porcelain containers for serum and virus blood, apparatus for separating out fibrin and clot, and bottles for storing and shipping.

Grouped around this essential unit may be a multitude of accessories, or the unit itself may be multiplied so as to provide for production on a large scale. Facilities for butchering, for cooling carcasses, for rendering virus pig carcasses, for handling virus in separate rooms, for keeping susceptible pigs isolated, for dipping and isolating new arrivals, for bacteriological work, for packing and mailing products, and for exposing serum and

virus pigs to calves so as to guard against foot-and-mouth disease, are just a few of the accessories that circumstance must include or eliminate.

Further detail in regard to equipment cannot be profitably discussed here. In all these things simplicity, cleanliness, convenience and low upkeep cost are the chief considerations. Good equipment invites clean operations, but in the last analysis the quality of the finished product is not determined by equipment. A careless operator will contaminate serum in spite of every convenience; a careful one will produce clean products under adverse working conditions.

Principle governing serum production. When a hog contracts cholera and recovers, or when it receives simultaneously hog cholera virus and protective serum, it is thereafter immune to the disease. The body cells, in self-defense, have elaborated substances, termed antibodies, which neutralize the effects of all hog cholera virus subsequently introduced into the system. In the ordinary immune hog these antibodies protect against any quantity of cholera virus to which the animal may be exposed, but they do not exist in sufficient concentration so that the blood may be used to protect other animals. Antibody elaboration must be further stimulated, and this is done by giving the immune an enormous intravenous dose

of virulent hog cholera blood. A slight reaction follows, and in the course of a few days the immune becomes a hyperimmune and comparatively small doses of its blood will protect other hogs exposed to cholera.

We are now ready to consider in some detail the various steps required in preparing anti-hog-cholera serum. In all these it is a principle that the operating room shall be clean and free from dust, that the floor shall be dampened, that the operator shall wear clean clothing and that his hands shall be scrupulously clean. The hands must not touch the serum or virus blood, and all instruments and containers with which the blood comes in contact must be sterilized before use. Antiseptic solution should be applied by means of a gravity irrigator or some other device which prevents the hands from passing alternately between operating field and antiseptic container. Exact records of each operation must be kept, and each hog used must be identified with a number tag.

Immunizing. Requirements. Two hypodermic syringes, one ten mil capacity or less, for virus, the other twenty mil capacity or more, for serum; scrub-brush and antiseptic solution, also anti-hog-cholera serum and hog cholera virus each in a separate, covered receptacle.

The pig is held by an assistant and the skin covering both armpits (or the inner region of both

hams) is thoroughly scrubbed with antiseptic solution. Then two mils of virus are injected into one armpit, and the required quantity of serum (about 35 mils for a 100 pound pig) is injected into the other. Deep injections are desirable.

Following this treatment the pig undergoes a reaction beginning in about five days and lasting about a week, during which time a permanent immunity to hog cholera is established. It is desirable to immunize prospective hypers as comparatively young shoats and to delay hypering until they have attained a weight of at least two hundred pounds, as a long interval between the date of immunizing and that of hypering favors potent serum. In no instance should this interval be less than sixty days.

The Virus Pig

In order that the immune may receive additional virus and become a hyper, a supply of virus must be procured. This is done by injecting susceptible shoats with lethal doses of hog cholera virus and collecting their blood after they sicken with the disease. A virus pig should be in thrifty condition, weighing near one hundred pounds. It should not be heavily infested with parasites. The dose of virus (about 2 mils) is injected in the same manner as has already been described, but no protective serum is given.

Four or five days subsequent to injection the pig should show a temperature near 106° F., and a day or two later marked symptoms of hog cholera should appear. As a very general guide it may be said that a virus pig is ready to bleed when it has carried a high temperature for about three days and when it has shown severe symptoms of hog cholera for about two days. A good strain of virus will bring this about in approximately seven days subsequent to the date of injection. The time required may be extended in certain individuals, but a virus that regularly requires more than eight days in which to "ripen" pigs for bleeding is not desirable for hypering.

Bleeding the virus pig. When the sick pig is ready to bleed for virus it is taken to the laboratory. In the preparation room the entire body is washed, and the animal is secured to a tilting operating table, revolving door or other device for securing it by the hind legs and suspending it head downward. The front legs are secured well apart and the snout tied backward, stretching the skin covering the throat. The throat and sternal region are then thoroughly lathered (an antiseptic soap is desirable), carefully shaved and rinsed, and an antiseptic solution is applied. If it is a male pig a clamp is attached to the prepuce to prevent dribbling of urine. Finally the entire body is covered with a cloth, previously dampened

in antiseptic solution, leaving only the throat exposed, and all is ready to draw the blood.

An ordinary two-quart fruit jar, previously sterilized, is a good receptacle. The sticking may be done with a large cannula designed especially for the purpose, or with a narrow bladed knife. In case a knife is used the hand should be held low on the throat so that the blade passes directly upward, the back against the dorsal surface of the sternum. The blade should not leave the median line, but should be forced upward until it severs a carotid or the anterior aorta near the bifurcation. A free clean incision made in withdrawing the knife facilitates rapid and complete bleeding. A pig weighing one hundred pounds should yield about one thousand mls of blood. If pigs are killed too late, after they are very weak, the yield is greatly reduced.

Handling the virus blood. Immediately after the blood is drawn it is defibrinated. This is done by closing the receptacle tightly and shaking it vigorously for a few moments. It is then marked for identification and placed in ice-water pending the time when the pig that yielded the blood can be autopsied. Assuming that the autopsy, which will be considered later, has been satisfactory, the next step is to separate out the fluid part of the blood, leaving the clot and fibrin behind. This is accomplished in various ways. Some use a cen-

trifuge of which the essential part is an enclosed, revolving, perforated cylinder; others pour the contents of the jars directly into funnels into which one or more thicknesses of sterile gauze have been placed; still others empty the jars into perforated funnels which fit into the tops of tall receptacles into which the fluid drains, and near the bottom of which is a turncock for drawing it off. Formerly clot presses were used universally as a final means of extracting the last drop of blood from the fibrin and clot, but this practice is gradually being abandoned. It increases the yield but little, and adds unnecessary débris to the blood, whether it is serum or virus. In all methods of handling the final act is to strain the blood through gauze, after which it is placed in storage bottles and refrigerated pending the time when it is required for hypering. The blood of several virus pigs is mixed after autopsies have confirmed its fitness for use.

This "hypering virus" may be kept forty-eight hours or even longer, but it is best to use it after it has been refrigerated about one day. It is well to strain it a second time just before it is to be injected. Preservative is never added to hypering virus.

The autopsy. The two essential requirements for a virus pig are that it shall show complete evidence that it was suffering with acute hog cholera

at the time it was killed, and that it shall be free of other infectious diseases which may be transmitted through its blood. The clinical history of the pig, and more especially the autopsy, enables us to select on this basis. If in addition to a clini-

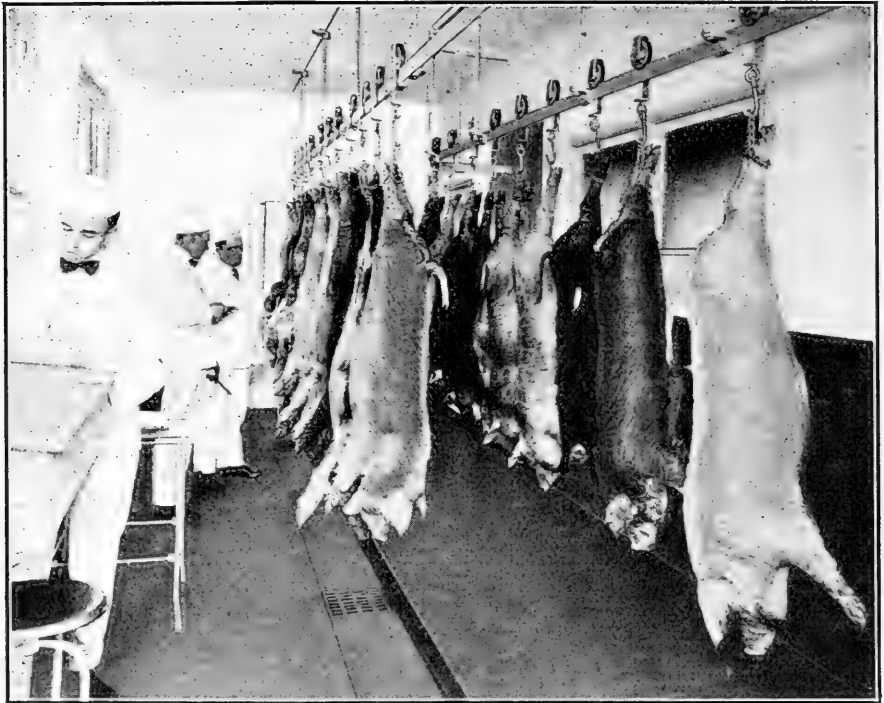


PLATE 9. Post-mortem room where autopsies on virus pigs are held. Each pig must show marked lesions of acute hog cholera, and must be free from other infectious diseases. (Courtesy Pitman-Moore Biological Laboratories)

cal history suggesting hog cholera a pig shows characteristic lesions of the disease, slight or severe, in two or more organs, we consider the first requirement satisfied. Generalized tuberculosis disqualifies, but slight and localized tubercular le-

sions do not cause rejection. Here, we believe, a very rigid interpretation is advisable, and in all cases which admit doubt the pigs should be rejected.

Pigs that show enormously enlarged, dark, pulpy spleens as well as those that bleed scantily and yield very dark blood do not produce satisfactory virus. The tendency in both cases is for the blood to defibrinate imperfectly and when it is mixed with good virus the entire lot may be ruined.

In the routine autopsy the skin, and all of the thoracic and abdominal viscera are examined, as well as the submaxillary and superficial inguinal lymph glands. In case of doubt, due to slight lesions, the mucosa of the larynx and popliteal lymph nodes should be included.

Disposal of carcass. Virus pig carcasses may be burned or rendered as circumstances direct.

The Hyperimmune

The immunes which are to be hyperimmunized and later yield serum should be carefully selected. The longer they have been immune to hog cholera, the better. They should be hearty feeders, in moderate flesh, and always strong and active. The ears should be moderately large, but thin and well veined, and the tail at least of average length so as to permit the required number of bleedings.

A weight near two hundred pounds is desirable. The intradermal tuberculin test should be applied to prospective hypers, and all reactors rejected.

Hypering. The immune is confined in a portable crate and the snout is secured firmly, drawing the head to one side. Its weight is then obtained and recorded, and it is wheeled to the preparation room in the laboratory. The entire body is wet thoroughly and a cloth dampened in antiseptic solution is thrown over it, leaving only the head exposed. One of the ears is lathered, shaved, rinsed and washed in antiseptic solution and the hog, thus prepared, is wheeled to the hypering room to receive the required dose of virus.

The hypering operation consists of injecting into an ear vein five mils of virus blood for each pound the hog weighs. The virus is placed in a graduated bottle which is closed with a rubber stopper, perforated in two places. Through one opening is passed a curved nicked tube which, extending to the bottom of the bottle, serves as an outlet for the virus when air pressure is applied; through the other is passed a shorter tube extending just through the stopper and through which air is pumped to produce pressure. Both are extended with rubber tubing, the intake being thus connected with a tank containing compressed air, and the outlet terminating in a slip fitting for the hypodermic needle which is to be introduced into

the ear vein. On this outlet tube is a pinch-cock to control the flow of virus. The bottle is filled with virus, the stopper is forced down tightly with

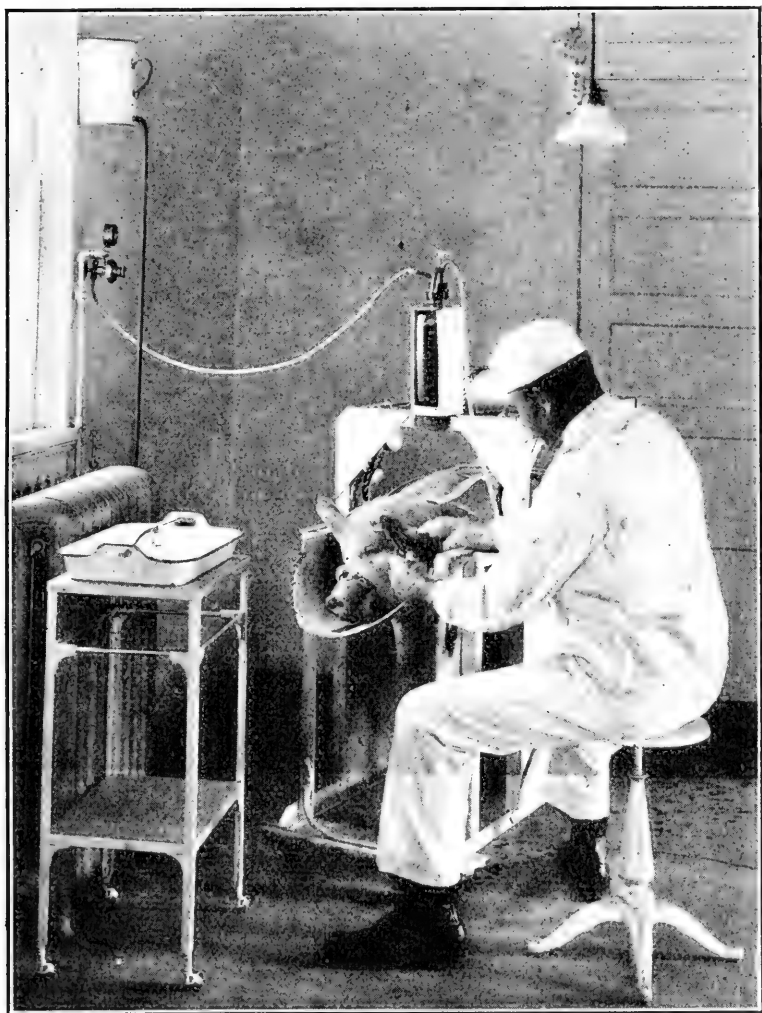


PLATE 10. A close view showing the hypëring process. A 200 pound cholera immune hog receives 1000 mils of virus in the ear vein. In ten days the animal is ready to bleed for protective serum. New York State Veterinary College at Cornell University

a screw clamp, enough virus is passed through the system to eliminate danger from air bubbles, the pinch-cock is closed, and all is ready to make the injection.

The vein into which the needle must be introduced usually conforms roughly to the contour of the outer margin of the ear, and is about one inch removed from it. A spring clamp is applied near the base of the ear, thus compressing this vein and rendering it plainly visible. The ear is drawn taut with the left hand, and with the right the needle is thrust quickly into the vein, passed rapidly along its course about two inches, and secured in position with the clamp which is no longer needed to compress the vein at the base of the ear. If the needle is properly in place there will be a backward flow of blood through it. Without a moment's delay it is now necessary to connect the needle with the supply of virus under pressure, and to open the pinch-clock allowing the virus to flow into the circulation. Otherwise the hog's blood may clot in the needle rendering the injection impossible. When the flow of virus is established, one must see that the needle is retained in place until the required quantity, already determined, has been injected. This will require from four to thirty minutes, the time being governed by the degree of pressure applied, by the size of the needle and the accuracy with

which it has been placed in the vein, as well as by individual differences in hogs that are not well understood. When the required quantity of virus has been injected, the pinch-cock is closed, the needle is withdrawn, and the hog is wheeled away and released.

This describes the hypering operation in its simplest form with everything favoring the operator. Volumes could be written about the attempts that end in failure. Practice is important, but a natural surgical touch amounting almost to instinct is required of the expert operator, and even he may experience unexplainable lapses in the execution of his technique. However, most of the annoyances experienced may be overcome, and it seems desirable to include a few suggestions which may aid the beginner in his work.

At first select hypers with ear veins straight and prominent; later it will be possible to hyper practically all subjects: begin the operation soon after the ear has been shaved; otherwise the vein may recede and be very difficult to distend so that the needle may enter it: use a needle with a perfect point; a dull one will roll the vein under it: Hold the ear out straight; otherwise the skin will be relaxed and the vein will be unnecessarily tortuous: after the needle has entered the vein do not release it until it is clamped firmly in position; the nub may drop carrying the point upward and

causing it to prick through the wall so that virus will escape from the vein and accumulate in the surrounding tissues when it is applied under pressure: if the needle tends to pucker the skin at the point of entrance, dampen both needle and skin (an atomizer containing alcohol is convenient for this purpose). In inserting the needle hold the index finger of the right hand well toward the point, between the ear and the needle; it is impossible to guide a needle when it is grasped at the nub only: if when pressure is applied virus is seen to escape from the vein and accumulate in the surrounding tissues, release the pressure at once; otherwise all chance of entering the vein in subsequent trials will be destroyed.

Before inserting the needle some operators connect it directly to the rubber tubing containing the virus under pressure, thus obviating annoyance incident to blood clotting in the needle or to accidental breaks in the slip connection due to struggling on the part of the hog. When this technique is employed one must depend largely on his sense of touch to determine when the needle is in position, for backward flow of blood cannot be observed. In case of doubt as to whether the needle has entered the vein, one may compress the tubing between the pinch-cock and the needle, at the same time observing whether the virus thus

forced out follows the course of the vein or is distributed in adjacent tissues.

Occasionally one encounters a fleshy-eared hog exhibiting no ear vein which is visible to the naked eye in ordinary light. Subjects of this kind may usually be hypered by darkening the room and holding an electric light bulb directly under the ear. Small, deeply covered veins are thus rendered plainly visible, and hypering is accomplished with surprising ease.

Dangers and accidents due to hypering. The ordinary immune hog will tolerate, without incident, intravenous injection of five mils of virus per pound body weight. Usually there is no evidence of pain or distress, and the animal lies quietly while the dose is being administered. In exceptional cases, however, sudden death occurs. It is a curious fact that if distress is to appear, it becomes evident before the first half of the dose enters the circulation. Thus it is not quantity alone that kills. Other factors may contribute, but the principal one seems to be failure of nervous control over capillary contraction. The capillary walls fail to adjust themselves to the increased pressure, and as a consequence distend and rupture. Usually the lungs alone bear evidence of this fact, as they contain the first set of capillaries through which the foreign blood must

pass, but occasionally the effect is observed in the skin. Severe and general congestion, interspersed with areas revealing slight or extensive hemorrhage, are the usual changes observed in the lungs.

Prevention of sudden death resulting from hypering is not always possible. Fatalities occur much less frequently if the virus used is first thoroughly cooled. Even ordinary refrigerator temperatures are not objectionable. As a second precaution a close watch should be kept on the hog during the process of hypering, though it is not always possible to distinguish between struggles due to fright and perversity and those due to genuine distress. Real danger is marked by a sudden inspiratory gasp or rapidly developing dyspnea, especially when these symptoms are accompanied by violent struggling and nervous symptoms such as twitching of the snout or eyelids and protrusion or shuttling of the eyeballs. If distress is not severe the flow of virus may be checked momentarily and then allowed to continue slowly, but as a rule it is best to release the hog and take no further chances. Usually in subsequent trials these hogs will tolerate hypering without incident.

Sometimes it is not until the hog is released from the crate that we observe symptoms. Vomiting occurs somewhat frequently at this time but

it is of no particular consequence. Great prostration and severe dyspnea are the symptoms which suggest impending death, especially when foam colored with blood exudes from the mouth or nostrils. Hogs suffering thus should be kept cool, their heads should be elevated, and they should not be subjected to unnecessary handling. Some will recover spontaneously. In fatal cases coma and shallow breathing precede death. We have tried hypodermic doses of strychnin under such conditions, but while temporary relief is afforded the treatment seems merely to delay death rather than to prevent it.

Fatalities sometimes occur when air is pumped into the vein. These may be avoided by forcing the outlet tube completely to the bottom of the bottle, and by allowing, previous to each operation, a quantity of virus to pass through the outlet sufficient to carry away bubbles that may be accumulated in the rubber tube. Air in the vein does not always cause death, but the risk is great, and avoidable.

Deaths from hog cholera as a result of hypering are practically unknown, except in hogs that have been purchased without a clear history of having been properly immunized.

During the interval between the date of hypering and that of the first bleeding for serum, about ten days, careful observations of the hyper are

necessary. The points to be determined are whether the hog has been vigorous and healthy, and whether this condition still prevails at bleeding time. Temperature readings, clinical observations and comparative weights are the sources of information, each being employed as circumstances direct. The average hyper shows a moderate and transitory fluctuation of temperature immediately following the dose of virus, and he may eat indifferently for a day or two, but as a rule his appetite is unimpaired, and he continues to gain in weight about a pound per day. If a hog's appetite has been greedy during the last seven days preceding the date of bleeding; if there has been no loss in weight or outward evidence of sickness; and if the temperature is normal when bleeding time arrives, we consider the animal a fit subject to produce serum.

Bleeding for serum. The hog is confined in a portable crate and wheeled to the preparation room. Bleeding is to take place from the tail which now requires thorough mechanical cleansing. Warm water and antiseptic soap are applied freely and a stiff scrub-brush is used to work up a lather. After several minutes of scrubbing, the tail, and a circular area surrounding its attachment, are carefully shaved. The body of the animal is then wet to settle dust that may be contained in its coat, and a cloth dampened in anti-

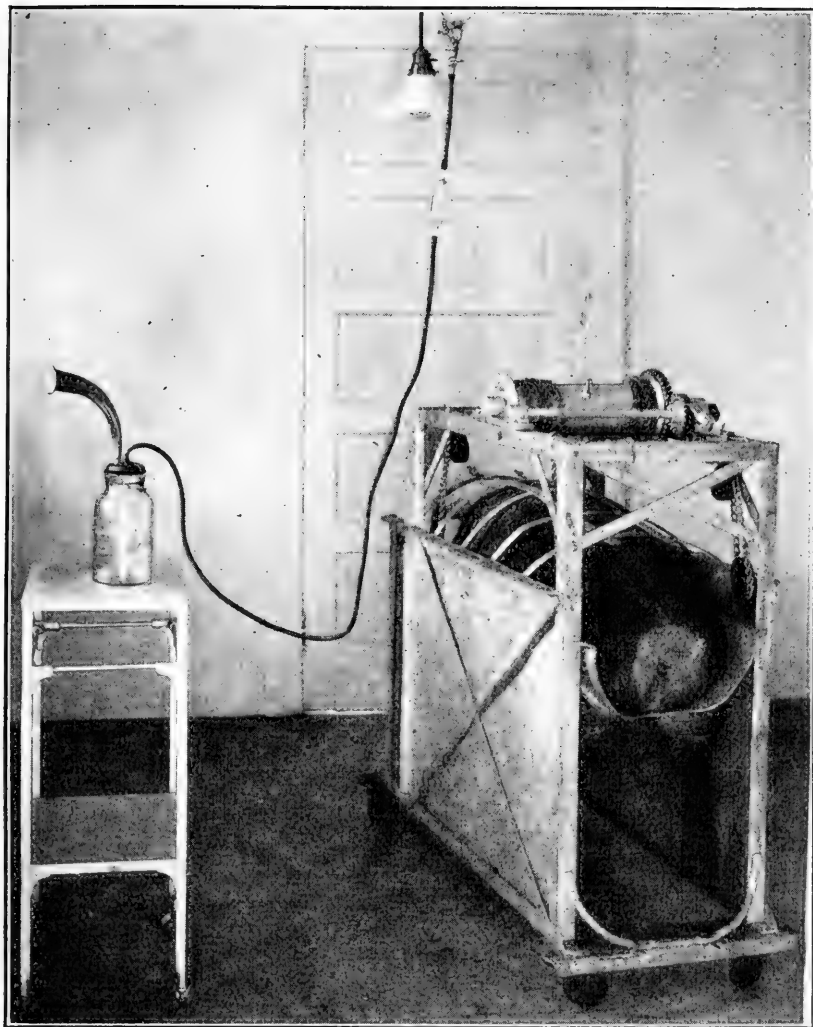


PLATE 11. Bleeding unit, and hog prepared for bleeding, but still uncovered. The fruit jar and breeding horn are clamped together and sterilized as a unit. The rubber cap is removed from the mouth of the horn immediately before the latter is applied to the hog's tail. New York State Veterinary College at Cornell University

septic solution and containing a hole through which the tail protrudes, is thrown over the body. Thus prepared, the animal is ready for the bleeding room.

Bleeding is accomplished with vacuum which hastens the process and retards coagulation. The essential bleeding unit consists of a curved metal horn, one end armed with a fitting which receives the mouth of a two-quart fruit jar, forming an air tight joint, and the other consisting of a round or oval-shaped opening presenting a moderately broad surface to be pressed firmly against the skin surrounding the tail, which member the horn encloses. Communicating with the interior of the unit is a tube which, continued with rubber tubing, connects with a pipe leading to a vacuum tank. Somewhere in the line is a turncock so situated that vacuum may be employed or released at will, and between this and the bleeding unit is an intake valve fitted with a small cup containing carbolized cotton through which air must pass to release the vacuum remaining in the unit when bleeding is completed and the turncock is closed, severing connection with the vacuum tank. A vacuum indicator is inserted in the line between the tank and the turncock.

The operator grasps the tail, disinfects it thoroughly, and dries it with alcohol. Then with shears designed especially for the purpose an inch

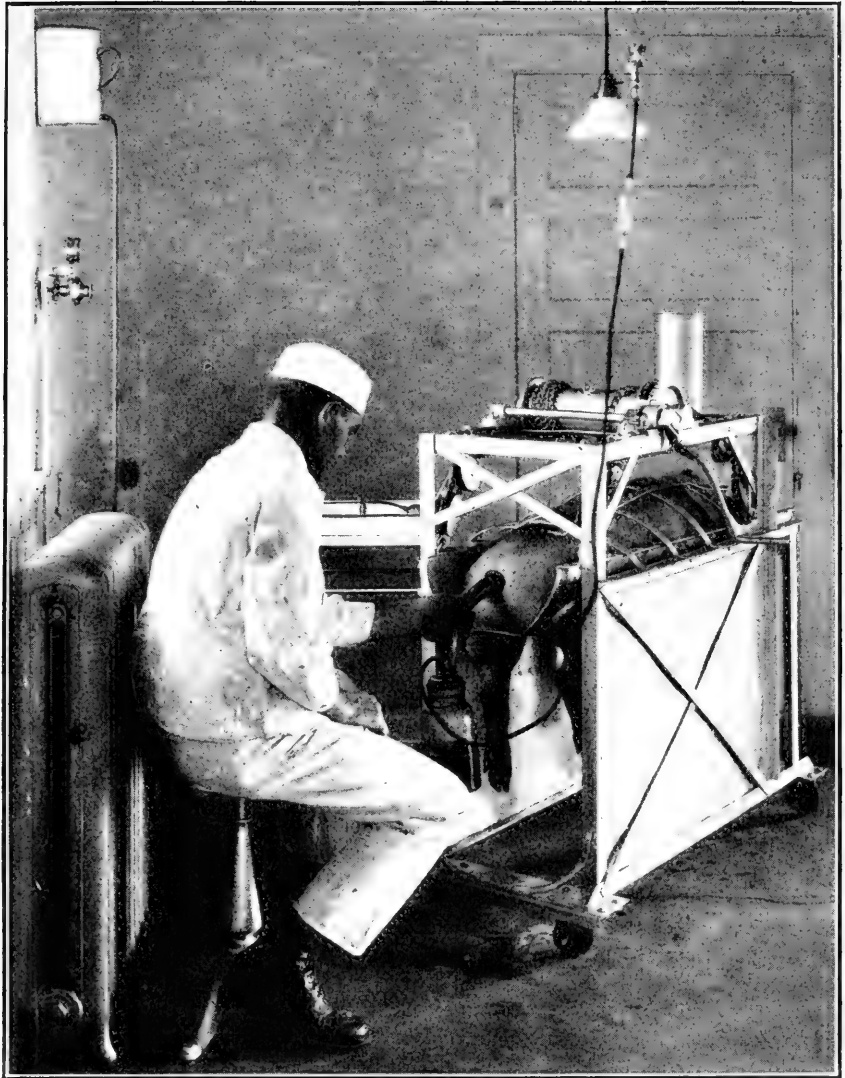


PLATE 12. Bleeding for serum. Vacuum is applied through the rubber tube, and the blood flows into the jar. 1000 mls of blood can be drawn in about 8 minutes. New York State Veterinary College at Cornell University

or more is clipped off the end, and the part remaining is guided into the bleeding horn, which is forced tightly against the body. When vacuum is applied the contact is rendered air-tight, and blood streams rapidly from the severed tail. Moderate and uniform traction should be applied during the process of bleeding. When the desired quantity of blood has been drawn, the turncock is closed, the vacuum remaining in the unit is released through the intake valve already described, and the tail is ligated near the end or the raw surface is seared to prevent further hemorrhage. It is well to cover all the shaved surfaces with ointment thus preventing chapping of the skin which may render subsequent bleedings difficult.

Bleeding technique is a determining factor as far as cleanliness of the serum is concerned, and too much importance cannot be attached to it. Thorough mechanical cleansing of the tail and surrounding parts is a first essential. Before the razor is used, warm water and soap should be applied vigorously for some time, thus softening the hair and removing all scurf. Disinfecting the tail previous to bleeding should never be allowed to degenerate into a mere perfunctory process. During the bleeding operation every effort should be made to prevent the vacuum from being broken, for this admits a stream of air which may be con-

taminated, and which, in any event, is sure to hasten coagulation of the blood.

We have not found defibrinating during the bleeding process either necessary or desirable. If it is done by shaking the jar into which the blood is flowing, it causes the hog to struggle, thus retarding the bleeding process and rendering breaking of the vacuum imminent; and if it is done by any device which renders shaking unnecessary during the time the blood is being drawn, complete defibrination can be brought about only by shaking the jar after bleeding is discontinued. On the other hand, if the hog is allowed to lie perfectly quiet, and if moderate and steady traction is applied after the vacuum is established, bleeding takes place rapidly, and almost without exception perfect defibrination will be secured if the blood is shaken immediately after bleeding is completed. Individuals differ, but the average hog bleeds best under about fifteen inches of vacuum. Contrary to what might be expected, a more perfect vacuum than this usually tends to retard bleeding rather than to hasten it.

Each hyper is bled once each week during a series of from two to four bleedings, after which it may be rehypered at any time. In rehypering only $2\frac{1}{2}$ mils of virus per pound body weight are required. Following this second dose of virus a

like series of bleedings takes place, the first occurring from seven to ten days subsequent to re-hypering. The final bleeding takes place from the throat in exactly the same manner in which virus pigs are bled, except that the blood is usually drawn into a deep porcelain receptacle, and defibrinated by whipping it with a large fork. If inspection does not disqualify, the blood of the hyper, which has been kept separate throughout the two series of bleedings, is admitted to test, and the carcass is placed on the market.

Handling serum blood. Immediately after the bleeding process is completed the jar containing the blood is sealed, and then shaken for a few moments to whip out the fibrin. When this process is completed the jar is placed in ice-water. Later, the fibrin is separated from the fluid by exactly the same process that is employed with virus blood. Here again, the clot-press is detrimental because it adds superfluous débris to the serum and causes it to be exposed to the air unnecessarily. After the defibrinated blood is strained there is added to it, as a preservative, 10 mils of 5 per cent aqueous solution of carbolic acid for each 90 mils of blood. The product is then placed in storage bottles, labeled, and refrigerated pending the time when enough has accumulated for a test.

In laboratories which do not clarify the serum,

the blood of each hyper is stored separately so that if the animal should show on autopsy generalized tuberculosis or other disqualifying disease, the blood may be discarded. Local conditions must govern these details. In our own laboratory where it is possible to purchase hypers which have not followed cattle and have not been fed raw creamery products, we always mix bleedings, in spite of the fact that we do not clarify the serum. We have never had a hyper show generalized tuberculosis, and in the few instances in which we have found the disease localized, we have used a guinea-pig test to determine the fitness of the serum for market. We believe this test has a wider application than is now accorded it.

FINAL PROCESSES IN SERUM PRODUCTION

Testing. Irrespective of detail in preparation, the final requirement is that the finished product shall pass a test proving its protective potency under carefully controlled conditions. For this purpose there is drawn a sample from a mixed lot consisting usually of about 100,000 mls of serum. Seven pigs weighing between 45 and 90 pounds each are selected for the official Bureau of Animal Industry test. Temperatures must be normal and all pigs in good physical condition at the time the test begins. Each pig is given 2 mls of hog cholera virus, five of them receiving in addition,

and at the same time, 20 mils each of the sample of serum to be tested. The other two receive no serum, but are employed as controls to determine the virulence of the virus. Daily observations are made and temperatures are recorded as required, preferably once a day. The essential requirements for a satisfactory test are that both pigs which receive virus only shall sicken during the test period (21 days) and that at least one of them shall sicken between the fourth and seventh days subsequent to injection, and shall before the fifteenth day suffer from hog cholera in a degree sufficient to cause death. As an additional condition, no more than one of the pigs that receive serum and virus shall show visible illness, and in case one should sicken it must be completely recovered before the twenty-first day following the beginning of the test.

Bureau of Animal Industry regulations governing the interpretation of tests will be found in the Appendix. In general, tests are classified according to results as "satisfactory," "unsatisfactory" or "no test," the latter giving indefinite results. The satisfactory test has already been described; the unsatisfactory test is usually referred to impotent or contaminated serum; re-tests are indicated when the serum-treated pigs or more than one of the virus pigs sicken before the fourth day, when the control pigs do not sicken

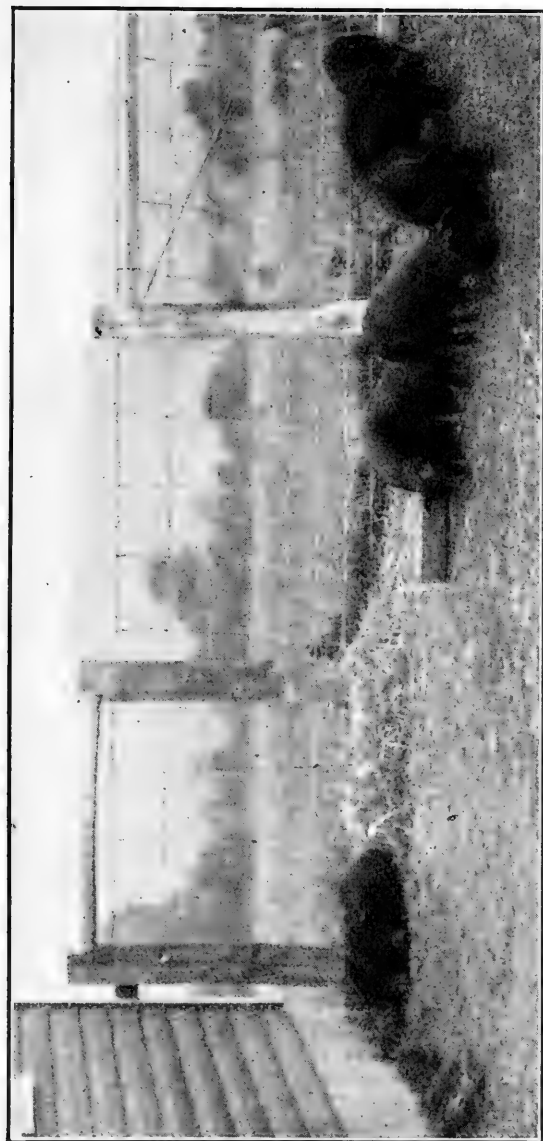


PLATE 13. Testing anti-hog-cholera serum. Seven days before the photograph was taken each pig in the lot received 2 mls of hog cholera virus. The six that are standing received protective serum at the same time that the virus was administered. The two huddled in the corner received no serum and are dying of cholera

as is required in a satisfactory test, or when intercurrent disease or accident intervenes.

Too much stress cannot be placed on the test, for it is here that all technique leading up to completion of the finished product receives its final confirmation. Careful observations are necessary as well as strict interpretations which withhold from use all doubtful serum. Regulations are a valuable guide, but they themselves require skillful interpretation, and no exact rules can be laid down which will serve their intended purpose under all circumstances. Is the serum highly potent? Is it free from organisms that will injure hogs into which it is injected? When test conditions answer both questions definitely in the affirmative, the serum is fit for use. If doubt remains it may be retested, and if it has failed to protect healthy pigs in average condition it should be discarded.

In our own work we greatly prefer an eight pig test in which two of the serum pigs receive 10 mils each of serum, two 15 mils each, and two others 20 mils each. We believe that these low doses give much more complete information regarding the potency of the product, thus allowing a greater margin of safety and adding to the confidence with which it may be used in the field. Out of the last 45 tests conducted in this manner 37 have passed without incident, intercurrent dis-

ease (heavy ascaris infestation) necessitated three retests which were satisfactory, one 10 mil serum pig died in each of two, one 15 mil pig died in one, and two were wholly unsatisfactory due to low potency. The test pigs ranged in weight between 27 and 105 pounds, the average being 59.

It is of advantage to select test pigs from herds in which no immunizing has been done and in which hog cholera has not appeared in recent years. It is well if all pigs in a single test can be litter mates. The pigs should not be subjected to long hauls just before they go on test, and during the test great care is necessary to prevent overfeeding of the serum pigs at the time when their reaction begins, which is about the time the virus pigs refuse feed entirely. As a routine measure it is a good plan to reduce the feed one-third or one-half on the morning of the fourth day of test, and to feed subsequently so that the serum pigs are kept just a little hungry.

It is interesting and highly instructive to observe the progress of a series of tests, and we know that some field workers would be more cautious in their vaccinating if this experience could be theirs. It is in this manner that we see results of the battle between protective and destructive forces, and are brought to realize how easy it is for some disturbing factor to turn the tide in favor of destruction. The virus pigs usually show

a temperature near 106° F. on the fourth or fifth day of the test, and this high level is maintained several days. Other symptoms of hog cholera appear a day or two after the temperature curve starts upward. The pigs which receive protective serum in addition to virus also undergo a reaction, which is slightly delayed and very mild as compared to that observed in the virus pigs. In some instances no temperature reaction is discernible, but usually readings reach a point between 104° and 105° F., considerable fluctuation between normal and this level being observed. As a rule the casual observer would detect no evidence of a physical reaction, but not infrequently the appetite lags just perceptibly for two or three days and in white pigs a slight flush may be observed in the skin. On the whole, all evidence of reaction has usually disappeared from the serum pigs before the tenth day of the test.

According to Bureau of Animal Industry regulations, serum which protects in doses required in their official test is suitable for use in the field under a dosage label as follows:

Sucking pigs.....	20 mls
Pigs, 20 to 40 pounds.....	30 mls
Pigs, 40 to 90 pounds.....	35 mls
Pigs, 90 to 120 pounds.....	45 mls
Pigs, 120 to 150 pounds.....	55 mls
Hogs, 150 to 180 pounds.....	65 mls
Hogs, 180 pounds and over.....	75 mls

Bottling and labeling. After a lot of serum has passed a satisfactory test it remains to place it in bottles of suitable size for shipping. In large laboratories this is done with machines designed especially for the purpose; in smaller ones it is done by placing the serum in a large covered container drained by a tubular outlet on which is fitted a few inches of rubber tubing. This tubing terminates in a small umbrella-shaped aluminum device, the serum flowing through the part representing the handle, and the bottle being protected from dust during the filling process by the part representing the cover. All bottles intended for shipping are sealed and placed in the refrigerator until they are needed.

A label should be placed on every bottle of serum shipped, and should include:

1. Release tag and license number if the laboratory is being operated under federal license.
2. Name and address of manufacturing firm or institution.
3. Dosage table.
4. Identification mark, which will enable the manufacturer to trace the exact history of any bottle of serum.
5. Return date, or latest date on which the serum may safely be used.
6. Brief directions for use and caution regarding methods of preservation.

The finished product. It has already been shown that all serum sent out is, or should be, subjected to carefully controlled tests in which it is required to protect laboratory pigs in much smaller doses than would be administered to like animals in the field. The protective defibrinated blood, called anti-hog-cholera serum, is the basic preparation from which all the more or less refined products now on the market take origin, and when it is prepared with careful technique it is in the original state a highly effective and safe immunizing agent. It may or may not be sterile.

Clear serum is "bloody serum" minus blood corpuscles. It is prepared from the protective defibrinated blood by various combinations of processes which, individually considered, include precipitation of the red blood corpuscles with navy bean extract, centrifuging, and filtering through various materials. Heat, 60° C., for one-half hour, is applied, which kills some contaminating organisms that may be present. An impression seems to prevail that all clear serum is sterile, but this is not true, for it is not necessarily subjected to temperatures or other treatment which will kill or remove all living bacteria.

The comparative merits of clear and "bloody" serum are the subject of much controversy, but as is true of other things of like nature, individual methods are the deciding factor. Clear serum,

if not subsequently diluted may be administered in somewhat smaller doses than can "bloody" serum, it is free from extraneous matter which has no immunizing value, and all other things being equal it is more likely to be sterile. On the other hand it usually becomes cloudy on standing, its keeping qualities and continued potency after heating, so often emphasized, are yet to be fully established, and it is more expensive than the "bloody" serum. "Bloody" serum contains corpuscles which are of no value in immunizing, and, like the clear serum, if it is not carefully prepared it may also contain excessive numbers of bacteria. On the other hand it is not subjected to complicated processes which invite error in technique, and it can be prepared much more cheaply, per immunizing unit, than clear serum.

Disregarding entirely the form of the finished product, the test, conscientiously applied and skillfully interpreted, is the swine breeder's guarantee of safety to his herd. Thus either clear or "bloody" serum, carefully prepared, is a safe and effective immunizing agent; neither, carelessly prepared, will produce the results the breeder and his veterinarian have a right to expect.

The relative merits of tail-bled and carotid-bled serum have also been the subject of much absurd controversy, for no scientific evidence has ever been submitted to prove one product different

from, or superior to, the other. Carotid-bled serum is a mere "talking point." Some laboratories situated near stockyards can produce it more cheaply than they can produce the tail-bled product, and this fact, rather than considerations based on the quality of the product, explains their preference for carotid-bled serum. Both products pass like tests before being released for use.

The keeping qualities of anti-hog-cholera serum vary with different lots, and with various methods of preparing and storing. Bureau of Animal Industry regulations place the expiration date at two years from the time the first bleeding in a particular lot takes place, and subject to satisfactory retest at the end of two years, another year may be added. Our own preference is for a shorter period, for in one or two instances we have known serum to fall away in potency before it was two years old.

Serum should always be stored in a dark, cool place. According to a limited number of tests conducted by Kernkampff, freezing does not injure it, but temperatures below the freezing point are not desirable. A temperature between 40° and 55° F. seems to be most favorable. After the seal on a bottle has been broken and a portion of the serum removed, the remainder should be used in the course of a few days, or discarded. It is always well to open the bottle out of doors, if all

the serum contained in it is not required for immediate use.

The scope and purpose of this book do not allow further detail which might profitably be included in a more inclusive text. In leaving the subject of serum production, let us emphasize again a few essentials which make for clean, potent serum. These include strong vigorous hypsers that have been immune to hog cholera a long time before being hypered; a highly virulent strain of virus that will "ripen" pigs to kill in seven days, or less; scrupulous cleanliness and strict antisepsis in all operations; rapid cooling of all blood immediately after it is drawn; no unnecessary handling or exposure of serum during the process of defibrinating and straining; and finally, careful observation of tests, with positive exclusion of doubtful serum.

Hog Cholera Virus

Hog cholera virus, called by the trade "simultaneous virus" because it is used in the field in conjunction with protective serum, is produced by giving shoats doses of virus (usually 2 mls each), allowing them to sicken, and drawing their blood while the disease is at its height. This blood is handled in exactly the same manner as hypering virus, differing from this latter product only in that there is added to it as a preservative, 5

mils of 5 per cent aqueous solution of carbolic acid for each 95 mils of blood. The pigs used to produce simultaneous virus must meet the same essential requirements as are met by those used to produce hypering virus; that is, they must show ample evidence that they are suffering with acute hog cholera at the time they are bled, and they must be free of all other infectious diseases transmissible through their blood.

Hog cholera virus is sometimes heated at 50° C. for twelve hours before being sent out, in which case a virulence test is necessary before it can be released for field use. In our own work we greatly prefer unheated virus.

Keeping qualities. Like protective serum, hog cholera virus must be kept in a dark, cool place. Bureau of Animal Industry regulations allow it to be used not more than sixty days subsequent to the date of drawing, but wherever a thirty-day limit is practicable, we believe it is safer. There are times when an inactive virus may result in as heavy losses as are sometimes charged to impotent serum.

Labeling. The virus label should include:

1. Release tag and license number if the laboratory is operated under federal license.
2. Name and address of manufacturing firm or institution.
3. Dosage table.

4. Identification mark, enabling the manufacturer to trace the exact history of any bottle of virus.

5. Return date, or latest date on which the virus may safely be used.

6. Directions for storing.

7. Brief directions for using, and cautions to be observed in destroying unused virus.

Hog cholera virus is dangerous material. One-half mil or even less will readily kill an ordinary susceptible hog if protective serum is not administered in conjunction with it. Thus hogs given simultaneous treatment in the field actually receive, as a routine measure, a lethal dose of virus. It is really remarkable that this practice results in so little trouble, but potential danger, slight though it is, exists whenever virus is used, and this fact should be well understood both by the veterinarian and his client. Under no circumstances should virus be used by untrained men.

CHAPTER VIII

METHODS OF USING ANTI-HOG-CHOLERA SERUM

Confining the animals. We will consider first methods of confining the animals to be treated. To one unaccustomed to handling hogs the task of confining and vaccinating a large herd of swine seems formidable, and not infrequently the difficulties presented, although largely imaginary, have led to costly neglect or procrastination. Chasing hogs to catch them is usually futile, it is time consuming, and if double treatment is to be applied, or if the animals are fat, the practice is positively dangerous. Ingenuity is required, and the veterinarian who can use the help and materials at hand to best advantage, enabling him to vaccinate a herd quietly and rapidly, and without exciting the animals, gains much in the confidence of his clients.

If the time that vaccinating is to be done is known to veterinarian and client the latter should tempt the animals into pens or small enclosures with feed and fasten them in securely. Bedding should be provided so that the hogs will be clean and dry. In cases of emergency, where this ad-

vance knowledge is lacking hurdles should be used to crowd the animals into the corner of a yard or

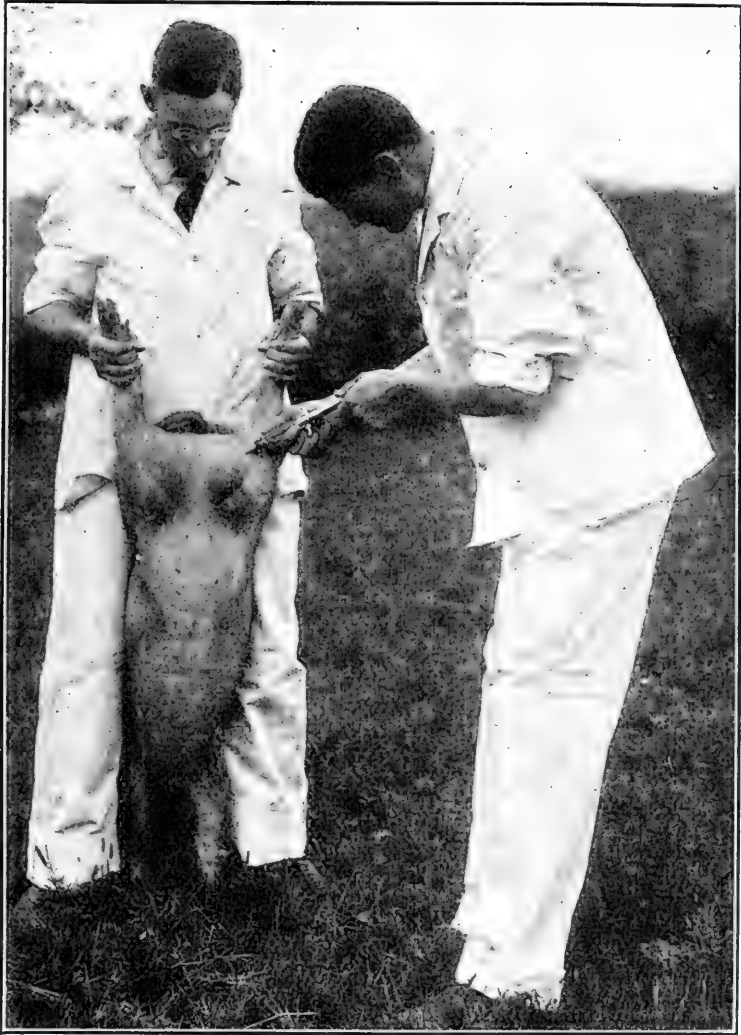


PLATE 14. Injecting anti-hog-cholera serum in the ham

pasture. In all cases in which fences are insecure it is important to mark each animal at the time it is vaccinated, so that if treated and untreated ones

should accidentally get together identification will still be possible. Paint, chalk, bluing or tincture of iodine are convenient for this purpose, or if a



PLATE 15. Method of holding shoat for injecting serum in axillary space

permanent mark is desired, the ear may be notched.

Assuming that the animals are fastened in small pens when the veterinarian arrives, confinement of the individual during the process of immuniza-

tion is the next step. As a site of injection, one may select the armpit, medial surface of the thigh, or the area immediately behind the ear. The site



PLATE 16. An improvised method of holding shoats for immunizing. Injecting serum in axillary space

chosen, the size of the animal and individual preferences determine the method of holding. If the site is to be the medial surface of the thigh, any

pig weighing less than sixty pounds may be seized by the hind legs and held with the head suspended, belly toward the operator. If the armpit is chosen the pig is suspended by the front legs which are drawn well apart.

Shoats weighing more than sixty pounds are confined in a variety of ways. Sometimes they are thrown and held on their backs; sometimes two men suspend them by their hind legs; at other times it is convenient to incline a V-shaped hog trough against a fence so that it forms an angle of about 45 degrees with the ground. Into this the shoats are placed on their backs, heads downward, and their snouts are allowed to slide under a cleat which extends across it. Perhaps the most serviceable method of handling animals of this size is to seize them by the front legs and set them on their haunches with their backs drawn firmly against the legs and body of the man holding them. In this position they are quite helpless and they are easily held as their weight rests entirely on the ground. Shoats thus confined are injected in the armpit.

In throwing larger hogs that are to be held on their backs for treatment it is well to seize them by the front leg on the nearest side. A common mistake is to reach under them for the off foreleg. Another convenient and surprisingly easy method of throwing is to seize the tail with the right hand

and the left hind leg with the left, pulling downward and to the right on the tail, upward and to the left on the leg. Like the double half-hitch in throwing a bull, this method of throwing hogs is effective, but its manner of action is a mystery.

Large hogs are seldom thrown but are confined either by means of a noosed rope which is placed well back in the mouth and tightened around the snout, or with one of the many types of hog-hold-

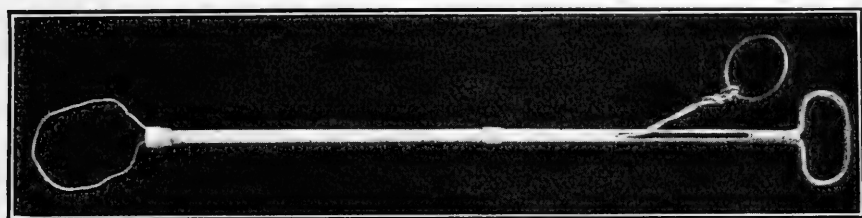


PLATE 17. Convenient hog holder made from $\frac{1}{2}$ inch gas pipe and flexible clothes wire. It may be disjointed in the middle for convenience in carrying

ers. In case a snout-rope is used it should be either $\frac{1}{4}$ or $\frac{3}{8}$ inches in diameter, and about fifteen feet long. An eye about $\frac{3}{4}$ inches in diameter is braided in one end, and through this the other end of the rope is passed to make a running noose. Directly around the rope forming the noose is braided a jerk-rope about a foot long. This device renders it possible to release a hog instantly, and saves time, for if it is not used releasing the animal sometimes is as difficult as confining it. A large rope tied in any manner to

form a running noose is clumsy to handle, and allows a great many animals to escape.

There is a great knack in noosing the snout of a large hog. Assuming that a person is right-

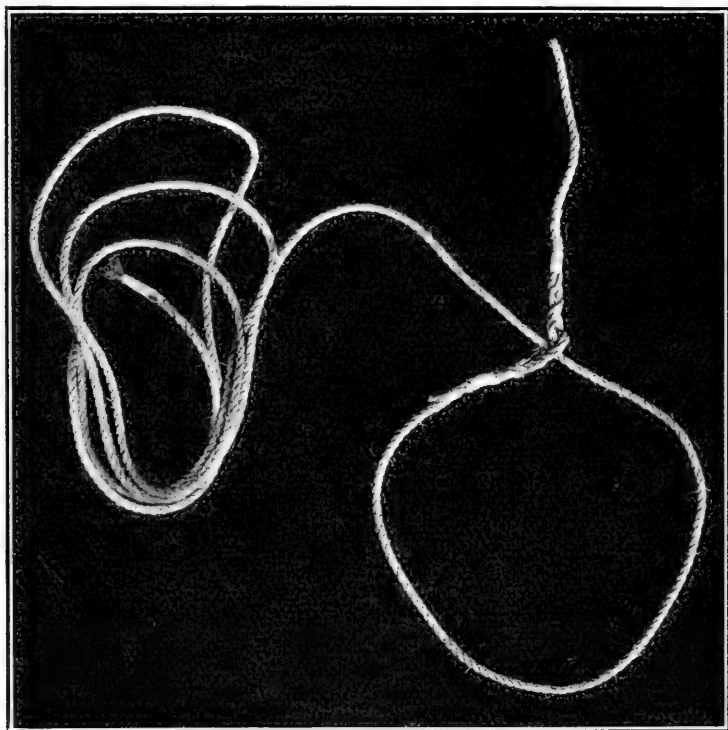


PLATE 18. Method of preparing snout rope for confining large hogs. The short "jerk-rope" renders it possible to release the hog instantly. $\frac{1}{4}$ or $\frac{3}{8}$ inch Manila rope is used

handed he should stand near the center of the pen and start the animal moving around it to the left, at the same time seeking a position at the hog's left shoulder. Holding in readiness a short section of the noose, and at the same time crowding

the hog suddenly and forcibly against the side of the pen with the right knee, one takes advantage of the fact that the animal opens its mouth to squeal or champ its teeth when its progress is thus momentarily arrested. The noose is slipped into the mouth, drawn backward quickly, and tightened



PLATE 19. Method of noosing the snout of hog. The animal is forced suddenly against the gate with the right knee, the noose is thrust into the mouth, drawn behind the canine teeth and tightened

around the snout. The free end of the rope is then secured and the animal is tapped on the snout to make it pull backward, for a hog will not stand quietly unless the rope is tight. In this position the site of injection behind the ear is readily available. When a sow and sucking pigs are to

be immunized, the sow should be tied and injected first, and released only after the pigs have been vaccinated.

Another method of confining large hogs is to connect two pens with a narrow, low chute, which can be closed at both ends. Into this a limited number of hogs are crowded tightly as they pass from one pen to the other, and the operator may reach over the side of the chute and inject the animals behind the ear. This involves some labor in preparation, but it is a rapid method of handling, and may be serviceable when a large number of hogs are to be immunized. Quiet hogs may sometimes be injected without resorting to noose or holder as the operation is by no means painful.

Methods of Using Serum

Preventive vaccination against hog cholera involves the use of just two materials; anti-hog-cholera serum, which is protective in nature, and which is prepared from the blood of hogs that are hyperimmune to cholera; and hog cholera virus which is the defibrinated and preserved blood of pigs that are suffering with hog cholera at the time bleeding takes place. With these two materials three methods of immunizing have been developed; serum alone, simultaneous (double, or serum-virus), and follow-up, which is a combination of the two first-named methods.

The practicing veterinarian is regularly required to select the method best suited to the conditions he encounters, and he can handle hog cholera with maximum efficiency only when he judiciously chooses and employs the particular method indicated. The selection is based entirely on the effects produced by each method, just as we choose drugs on the basis of their action. When once these effects are well understood, the choice involves no great difficulties.

Serum alone method. This consists of deep injection of the required quantity of serum. If the animals thus treated are not infected¹ with hog cholera immediately before or during the four weeks following serum administration the immunity conferred may, with rare exceptions, be depended on four weeks. In many individuals it lasts much longer. Swine more than twelve weeks old that receive serum alone and are infected with cholera immediately before immunization, or during the three or four weeks following, are thereafter permanently immune. The effect on pigs less than twelve weeks old is still a matter of controversy, but at present we are not safe in depend-

¹ Much misunderstanding has arisen because of the loose use of the terms "infected" and "exposed." The first term implies that hog cholera virus sufficient to produce the disease has actually entered the system; the second implies that the animal has been in close contact with virus from any source, but infection may or may not have taken place. Hogs given serum alone and infected with hog cholera acquire a permanent immunity; if they are exposed but not actually infected the immunity is temporary.

ing on serum alone plus natural infection to protect young pigs more than four weeks.

Technique of serum administration. Requirements. Serum in covered container, or in a bottle fitted with cannula through which it may be drawn; hypodermic needles, and syringe, the latter preferably one of 30 or 40 mil capacity; antiseptic solution in large container, and scrub-brush, for disinfecting site of injection; antiseptic solution in small container for disinfecting needles and syringe. In field work these are placed conveniently upon an improvised table consisting usually of a box covered with a clean towel or oilcloth.

The pig is confined in the manner already described, and the site of injection is thoroughly cleansed with the scrub-brush dampened in antiseptic. If syringe and needles have not been previously sterilized, they should now be thoroughly disinfected, after which the required quantity of serum is drawn into the syringe and injected deeply into the tissues. As the needle is withdrawn it is well to pinch the skin to prevent backward flow of serum. Massage is now applied if required, the site of injection is again dampened in antiseptic, and the pig is released.

Choice of the site of injection is governed by the size, condition and intended use of the animal, by the method of confining, and by individual preferences. All other things being equal we pre-

fer the armpit because the skin covering it is usually clean, the serum enters the tissues freely, and with each step the animal takes, massage is automatically applied. Very young pigs are most

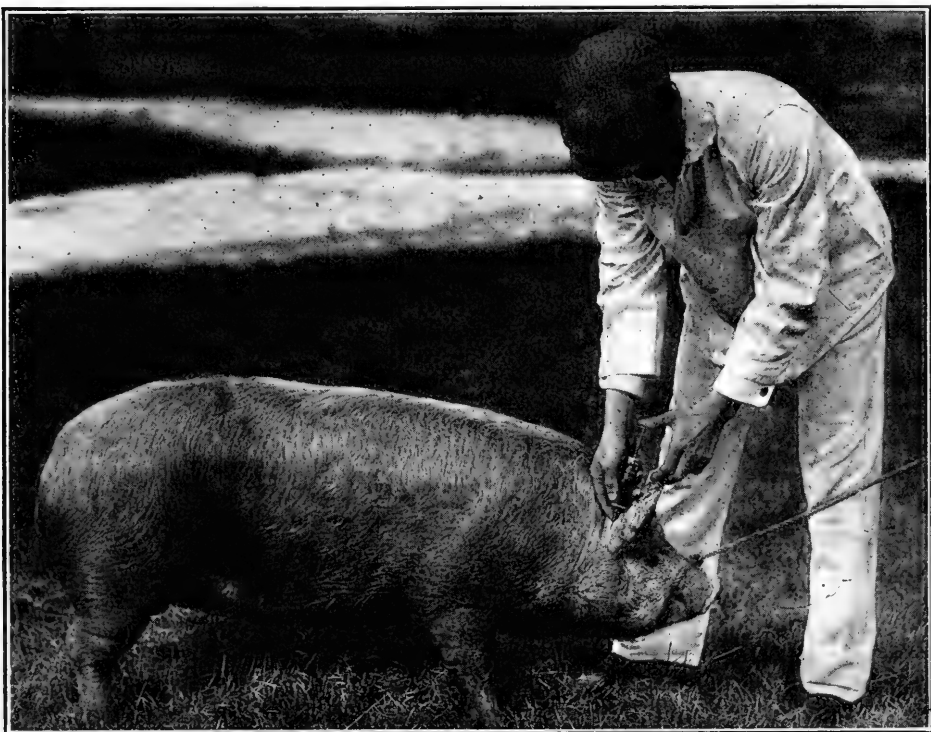


PLATE 20. Injecting serum behind the ear. The needle is thrust deeply into the loose areolar tissues, and very little force is required to expel its contents

conveniently confined for injecting in the ham. Heavy hogs, especially pregnant sows, are almost always injected behind the ear, because it is safer and more convenient to confine them standing. Hogs nearly ready for market should not be in-

jected in the ham, and young pigs and shoats are not injected behind the ear. Sometimes serum is administered in the flank, or in the loose tissues immediately back of the elbow, but we believe neither practice has much to recommend it.

Rapid and complete absorption of serum is greatly to be desired, because it gives the highest and most prompt immunizing effect, and tends to prevent abscess formation. Some will inject no more than 20 mils of serum in a place, believing that a greater quantity will be absorbed but slowly, but it is the placing and distribution of the dose, much more than its size, that govern absorption. In real small pigs it is well to divide the dose, and whenever possible the practice may be followed in older animals. In injecting young pigs the parts that receive the serum should be kneaded gently after the needle is withdrawn; in larger animals the needle should be thrust deeply into the loose tissues immediately behind the ear, and after the injection is completed the ear should be drawn forward and vigorous massage applied in order to distribute the dose. Serum injected immediately beneath the skin, forming a distinct welt, absorbs but slowly, and when it fails to spread in the deeper tissues, as evidenced by undue pressure required in making the injection, rapid absorption cannot be expected. A syringe

which operates easily and requires uniform pressure on the plunger should always be selected.

Cleaning and disinfecting the site of injection are processes frequently neglected, because the hog is proverbially difficult to infect. He can be infected though, as some have found to their sorrow. If hogs are at pasture or in clean, dry, well-bedded pens, cleaning is not difficult. Some simply paint the skin with tincture of iodine, and this answers well when the site of injection is both dry and clean, but tincture of iodine is not suitable for use on wet surfaces. We have found nothing better than a good coal-tar disinfectant applied with a stiff scrub-brush, for this removes all dirt and scurf, in addition to furnishing the desired antiseptic action. If pigs are unusually dirty the site of injection should first be cleaned with warm soapsuds. Good technique includes thorough mechanical cleansing, and nothing else will take its place.

Dosage of serum. The best rule is to give at least as much serum as the label requires. Serum varies widely in immunizing units per mil, and although the margin of safety—the increase of the field dose over the laboratory test dose—observed in individual laboratories is not the same, doses recommended in any particular laboratory are, in a very general way, determined by its indi-

vidual methods of preparing and testing. Dosage is based on weight, and one not accustomed to estimating weights of hogs should weigh one or more before beginning work, for a common and disastrous error is to estimate far too low, and to give correspondingly small doses of serum. Not infrequently we have known weights to be estimated at less than half what they actually were. We believe a common error in dosing, and one for which labels are frequently responsible, consists of giving all hogs above a certain weight a fixed quantity of serum. Thus on one label we read: "Hogs 180 pounds and over, 75 mils." A hog weighing 180 pounds may properly receive 75 mils of average serum, but one weighing 500 pounds will not be adequately protected by that quantity. Under all conditions under which it is known or suspected that the hogs have resistance below the average, it is a wise precaution to increase the dose measurably. In badly infected herds it should be doubled.

If serum is carefully administered, with due precautions regarding rapid absorption, it is practically impossible to overdose, and there is no disease or condition of swine, so far as we know, that even an unnecessarily large dose of serum alone will affect unfavorably. Thus in case of suspected hog cholera, in which the diagnosis cannot be clearly established, it may, and should be, admin-

istered; and in case deviation from the dose table seems desirable, a quantity unnecessarily large is preferable to one dangerously small.

Therapeutic value of serum alone. Serum is employed almost entirely as a preventive of hog cholera, but it possesses some therapeutic value when used in generous doses early in the course of the disease. Herein lies the reason for increased doses in badly infected herds—many animals apparently well are really in the first stages of hog cholera. Ordinarily we do not regard treating hogs visibly sick with cholera as a profitable venture, but when the disease appears in mild form, or when the animals are adults or of exceptional value, we are more than repaid for our efforts to save them. Double doses of serum are recommended under such circumstances, and ordinary doses may follow at intervals of from three to seven days, as the condition of the animal requires.

Good nursing as an adjunct to serum treatment is of the utmost value. A plentiful supply of fresh water should be furnished, to which may be added a saline purgative when there is constipation. The diet should be severely restricted, and under no circumstances should unconsumed food be kept before the animal. Warm milk alone is an excellent diet for hogs suffering with cholera.

Dangers and after-effects of serum alone im-

munization. Occasionally rough handling during the process of vaccinating will injure an animal, but this is not to be charged to the effect of serum. Sometimes, especially in very young pigs, a temporary stiffness or lameness exists for a day or two following treatment, but this is exceptional, and usually it is of little consequence. Large quantities of cold serum, especially when the dose is not well distributed, sometimes cause this trouble in an aggravated form. The obvious precautions are to use due care in injecting, and to warm serum that is to be administered to young pigs in cold weather. A temperature approaching blood heat is desirable, and may be secured by placing the bottles in warm water.

Very exceptionally there is observed, immediately following serum administration, a rapidly spreading local infection often involving an entire quarter and encroaching on other parts. There is acute lameness in the affected quarter. The area involved is either doughy in consistency, or else gas formation is evident, and under both conditions there is pronounced edema. The skin usually assumes a purple hue. As a rule, animals thus affected die in a short time. We have seen but a limited number of such cases, and with one exception, all could be traced to gross carelessness in technique, or to working conditions which rendered even average technique impossible. We

have never seen a considerable number of animals in one herd thus affected.

Abscesses follow serum administration infrequently, and like the rapidly terminating type of infection just described, they are usually associated with faulty technique or conditions below the average as far as sanitary surroundings of the animals are concerned. They occur most frequently in poorly nourished, weak animals, but are not always thus limited, nor is it possible in all cases to ascribe them to bad technique. The bacterial flora of the particular surroundings in which the immunizing is done seems to play an important part, but even this factor may be controlled to a great extent by the free use of disinfectant. Dust contamination of serum and instruments also favors abscess formation, and for this reason one should work out of doors whenever possible. Failure to distribute the dose of serum thoroughly sometimes results in local inflammation, leading to abscess formation. Abscesses are rare when the serum is not contaminated, when care is used in administering it, and when the treated animals are in reasonably clean quarters.

Vaccination abscesses usually encapsulate and form slowly, and although they sometimes reach a considerable size and retard the growth of the animal to some extent, they rarely threaten its life or cause general symptoms of disease. If

they occur in the hams of hogs ready for market they are highly objectionable, as they cause condemnation of the entire quarter in which they are located. The handling of vaccination abscesses consists of opening them when the first evidence of fluctuation appears, pressing out the thick, greenish-yellow pus which they usually contain, and irrigating the sac with weak antiseptic solution. In opening, the incision should be made with due regard for continuous drainage.

Considerable space has been devoted to these untoward results which sometimes follow serum administration, but on the whole they are uncommon when reasonably good technique is employed. One who is careful will immunize hundreds and even thousands of hogs without encountering difficulties of this kind, but it is well to know that they sometimes occur, and to understand the importance of seemingly trifling influences that operate to cause or prevent them.

Summary of action of serum alone.

1. Produces in hogs not infected with cholera near the time of its administration a passive immunity lasting about four weeks.

2. Produces active and permanent immunity in swine more than twelve weeks old that are definitely infected with cholera immediately before immunization, or during the three or four weeks following it.

3. Produces an active and permanent immunity in many pigs less than twelve weeks old which are definitely infected with cholera near the time of treatment, but cannot be depended on to produce permanent immunity in all young pigs.

4. Does not affect other diseases unfavorably, and if it is carefully administered, untoward results following its use are practically negligible.

Indications for serum alone.

1. In seemingly well and exposed animals in infected herds.

2. In all cases in which a four-week immunity will meet the requirements. (Show hogs under some circumstances, those near the end of the fattening period, breeding animals crated for shipping.)

3. In all cases in which immediate protection is required and simultaneous treatment cannot be safely administered. (Sows near farrowing time, weak unthrifty animals temporarily threatened with hog cholera.) See also follow-up treatment.

Contra-indications for serum alone. Serum alone is contra-indicated when the following conditions coexist in the same herd or animal.

1. A permanent immunity is desired.

2. Hog cholera infection does not exist.

3. Simultaneous treatment may safely be administered.

Simultaneous or double treatment. This

method consists of giving serum in exactly the same manner as has already been described, and of administering at the same time, and with a separate syringe, the required dose of hog cholera virus. Usually the dose of serum is given in one of the sites of injection already mentioned, and the virus at the corresponding point on the opposite side. The technique of administering virus does not differ from that employed with serum, except that special care is required in disinfecting the site of injection after the needle is removed. Also the dose of virus is so small that massage is not required. No virus should be allowed to drop on the ground, and all that is not used should be burned.

Simultaneous treatment possesses the great advantage of producing a permanent immunity in all swine that are more than twelve weeks old, and in many of those that are younger. On the other hand it involves the use of a lethal dose of hog cholera virus, thus producing certain sequelæ and adding specific dangers that are not associated with serum alone treatment.

Dosage of serum and virus. The same principles that apply to dosage of serum administered alone, apply when it is given with virus. We give at least as much serum as the label indicates, increasing the dose when we are compelled to administer simultaneous treatment to hogs below

average in resistance. In using virus the label is likewise our guide. Although in giving simultaneous treatment to hogs we regularly administer a lethal dose of virus, we should not let that fact tempt us to decrease the quantity. Too much stress has been laid on carefully graded doses of virus and on the necessity for balancing virus and serum doses. One mil of virus will kill almost as regularly and quickly as three, and an ordinary dose of serum will protect against either quantity. The dose of serum is not governed by the quantity of virus, but by the potency of the serum, which is reflected on the label, and by the size and condition of the hog. Thus, if circumstances compel us to give simultaneous treatment to hogs below average in resistance, we increase the dose of serum, but leave the virus dose unchanged. The primary aim is to give enough virus to infect, and enough serum to protect against an infecting dose. In our own field work we never give less than one mil of virus nor more than two mils, our preference being for a dose approaching the latter figure in all swine weighing more than seventy-five pounds.

After-effects and dangers of simultaneous treatment. A reaction, very slight in the vast majority of cases, but severe in others, usually follows simultaneous treatment. In effect, the animals go through an attack of hog cholera which

is so light that symptoms do not appear, but if temperatures are recorded the curve will usually show slight elevation and more or less fluctuation between the fifth and twelfth days following immunization. Under unfavorable conditions the reaction becomes relatively more severe, and symptoms of hog cholera may appear. If these are slight, complete recovery will take place; if they are severe, they threaten the life of the animal; and if it dies its death is due to hog cholera just as truly as it would be if no serum were administered. Sickness and deaths due to hog cholera following simultaneous treatment are termed "breaks" or "vaccination cholera." If the trouble appears during the first three weeks following treatment it is called a "serum break" the supposition being that the serum is impotent and allows the virus to kill the animal; if it appears after a longer time it is termed a "virus break," the effect being ascribed to the fact that inert virus has been administered and the serum produces only a temporary immunity, which, as it disappears, leaves the herd again susceptible.

In reality, "serum breaks" are due to a variety of causes, among which are impotent serum, faulty technique in vaccinating, insufficient doses of serum, and, in addition, any influence whatsoever that temporarily lowers the resistance of the animals during the two or three weeks subsequent

to vaccination. Most important among these may be mentioned shipping, weaning, castrating, heavy ascaris infestation in which the gall ducts are filled with the parasites, overheating incident to handling during immunization, severe exposure in cold rains during the reaction period, injudicious feeding during that time, and general unthriftiness due to any cause. These are not imaginary influences that *may* cause "breaks," but are real influences that *do* cause them, and while they may be repeatedly ignored without dire consequences, the tendency is to ignore them once too often.

The practicing veterinarian is helpless in regard to the potency of the serum he uses. He has no opportunity to test it, and must therefore accept it on faith. His safest plan is to secure it only from the most reliable sources. Of course if the virus used is up to standard, and the serum is impotent the hogs that receive the two simultaneously will probably die, and no veterinarian who has had this result follow his work will soon forget it. It is well to remember, though, that impotent serum is just one of many causes of so-called "serum breaks" and that the remainder of these causes are for the most part controlled by the practitioner or breeder. There is a triple responsibility associated with all simultaneous treatment, and neither serum producer, veterinarian

nor breeder should throw stones until he is sure he is not living in a glass house.

Shipping hogs immediately after simultaneous treatment has been administered, or worse still, holding them three or four days and then shipping them so that they will be on the road at the time the reaction following treatment is in progress, is a fruitful cause of serum "breaks." We are aware that this practice is stoutly defended by many, principally by those who administer the treatment in stockyards, see the hogs loaded in cars, and never see them again. The practice is not defended by veterinarians who are on the receiving end of the line, for it is a well-known fact that "serum breaks" often occur soon after these hogs reach the farms on which they are to be fattened, and it is fortunate indeed if hog cholera is not thus transmitted to other herds in the vicinity. This method of handling hogs may be necessary under present conditions, even if it must carry with it the risks we have mentioned, but granting that it is necessary, let us at least recognize the dangers in their true proportions, and work toward a better method of handling feeding hogs.

Lowered resistance due to shipping accounts for many of these "breaks," yet the tendency is to charge them to impotent serum. The best serum that can be manufactured will not protect all

animals thus handled, but the fact that many lots of hogs will endure it, leads some to think that all ought to do so. Individual differences exist, and while they are not always obvious, the lots that "break" more often consist of hogs that have been held in stockyards a long time, those badly infested with parasites, or suffering with respiratory diseases. Distances traveled to and from the stockyards, and the degree of crowding of the cars are also potent factors in determining the hazards of shipping simultaneously treated hogs.

Hogs are not fit subjects for simultaneous treatment just as they are unloaded from long railway journeys. It is best to give these animals serum alone at this time, and simultaneous treatment two or three weeks later. This is the follow-up treatment which we have already mentioned, and which will be considered separately in this chapter.

In farm hogs, weaning, castrating, ringing, and the absurd practice of knocking "black teeth" out of all pigs may operate individually or collectively to lower resistance and render simultaneous treatment dangerous. Due to pressure of other work pigs are frequently neglected several weeks, then suddenly there is a desire to do all of these things, and immunize, at the same time, in order to avoid handling the animals more than once. The wonder is that pigs will frequently, even usu-

ally, survive the ordeal, but exceptions prove the rule—and embarrass the veterinarian. In several instances we have known men to castrate pigs during the week following simultaneous treatment. In some of these a number of the castrated pigs died, while the female pigs, which remained as checks, survived, thus furnishing excellent but rather involuntary and costly experiments. Pigs are best castrated as sucklings, but in any event, it is well to separate castrating and simultaneous treatment at least two or three weeks.

Ascarids may exist in the intestine in large numbers without appreciably lowering the resistance of simultaneously treated pigs, but if the parasites enter and occlude the gall duct, the infested hog shows a remarkable intolerance for virus. We have observed this intolerance again and again both in test pigs and in the field. Practitioners cannot always avoid trouble due to ascarids, for granting that they know the parasites exist in a herd, it is not always possible to determine their location in the individual, and often it is not safe to delay treatment. Severe jaundice in pigs is usually due to ascarids in the gall-duct, and its presence, easily observed in white pigs, should suggest caution.

Overfeeding is injurious to pigs passing through the reaction following simultaneous treatment. Any one who has observed serum tests knows

that. Often there is no change in the appetite during this time, but if a few animals in a lot eat scantily, the others gorge themselves on the surplus thus rendered available, and a period of distress or dullness follows, during which the virus may get in its work. A simple rule is to feed so that the animals remain just a little hungry after each meal, and to be prepared for a slight lagging in appetite between the fifth and twelfth days following treatment.

Methods of preventing "serum breaks" are obvious when the causes of these "breaks" are understood. Full doses of potent serum administered with due regard for rapid absorption, and proper caution in regard to treating hogs below average in resistance are the two essential considerations.

Handling "serum breaks" involves first of all informing the owner of the animals, before serum is administered, that such "breaks" are possible but by no means probable, and asking him to observe the herd carefully and report any sickness that may appear during the three weeks following treatment. Should a "break" occur prompt measures are required. If only two or three hogs out of a herd of considerable size appear dull, and if these have sickened later than the twelfth or fourteenth day following vaccination, it is well to take temperatures on several animals in the herd.

If the temperatures vary between normal and a little above 104° F. and if there is no visible dullness, serum alone may be given to the sick animals only; but if sickness appears before the tenth day, if several hogs are dull, or if a number of them show temperatures near 106° F. the entire herd should receive full doses of serum alone without delay. Most "breaks," taken in time, can be checked.

Abortion in sows has been caused by simultaneous treatment, but it is rather unusual, and occurs most frequently during "breaks" due to the causes we have mentioned. Sows near farrowing time certainly should not receive serum and virus, but when they are in the early period of gestation we are frequently compelled to assume the slight risks as a necessary evil.

Stunting may result from simultaneous treatment, and we are told that one of America's most famous pure-bred breeders had his herd ruined by unthriftiness following vaccination. We do not know the particulars, but we do know that such consequences need not follow simultaneous treatment judiciously administered, and we know that hundreds of pure-bred breeders maintain fine herds immune, and are satisfied. We have already enumerated a few of the factors which cause "breaks." Any one of these may cause death, or falling just short of such a result, stunt the ani-

mal. Thus it is the abuse of simultaneous treatment rather than its use which incriminates it.

Elimination of hog cholera virus in the excretions of simultaneously treated pigs sometimes takes place for a few days during the resulting reaction. There was a time when this fact was denied, but no person experienced in handling hog cholera would seriously question it to-day. Reactions vary between one extreme in which no temperature elevation is recorded, and the other rather unusual one in which death takes place. In the first instance virus elimination is rare, but as the latter extreme is approached, it is the rule. Most hogs do not eliminate infectious material, but the exceptions to the rule are so numerous that it is not safe to keep susceptible animals with those that receive simultaneous treatment.

Because of the danger of virus elimination, a period of quarantine is usually imposed on simultaneously treated hogs. The duration of this quarantine is prescribed by law in most states, the usual time varying between twenty-one and thirty days, with extension in case "vaccination cholera" appears. Hogs that have shown no physical evidence of disease are very rarely eliminating virus at the end of twenty-one days following serum-virus immunization.

"Virus breaks" are not manifest until several weeks following simultaneous treatment, and they

are due to inert virus, insufficient doses, and, very probably, to giving simultaneous treatment to pigs too young. If virus is inert infection is not produced, active immunity is not established, and if hogs chance to be exposed to cholera after the passive immunity due to the serum has disappeared, they readily contract the disease. If a pig more than twelve weeks old receives a full dose of virulent virus as a part of simultaneous treatment and remains well during the following four weeks, his immunity to cholera may be accepted as a fact; if a herd that is given simultaneous treatment passes the first four weeks without incident and later "breaks" with hog cholera, we may safely assume that inert virus was used, or that doses ridiculously low were administered. Sometimes inert virus is sent out with impotent serum that will protect against no other kind; sometimes virus is used too long after being drawn; and if it is heated—we do not believe it should be—there is some danger of killing it.

Prevention of "virus breaks," when one understands their causes, is simple. Provided one treats pigs more than twelve weeks old, a full dose of virulent virus in conjunction with the serum used in simultaneous treatment is all that is required. A breeder who is familiar with the benefits and hazards of simultaneous treatment will not be greatly disturbed if a shoat or two should

die of "vaccination cholera" when he has his herd immunized; he may even view a more serious "serum break" complacently, but if his swine receive simultaneous treatment as shoats and die of hog cholera when they are about ready for market, he has a real grievance, which he will be slow to forget. It is fully as important that virus shall be virulent as it is that serum shall be potent.

"Hemorrhagic septicemia" forms a convenient and altogether too common alibi for both "serum breaks" and "virus breaks." If either occurs (and disease which is really hog cholera is called "hemorrhagic septicemia"), this automatically absolves from all blame the serum producer who sells impotent serum or inert virus; it excuses the man who abuses the products in administering them, as well as the breeder who subjects his animals to improper care during the resulting reaction. The only defect in such an alibi is that it does not save the hogs or tell us what really kills them. When hogs kept under average farm conditions receive simultaneous treatment and any considerable number of them develop febrile disease during the following three weeks, unless a cause other than "hemorrhagic septicemia" is obvious the chances are ten to one that the primary cause of the disease is hog cholera virus. Under such conditions no other cause can be accepted unless negative filtration experiments, requiring

about ten days, are carried out. The field man who represents a laboratory which sells questionable serum, and who pronounces such "breaks" "hemorrhagic septicemia" on information obtained from a few autopsies or a brief bacteriological examination, must, in mercy, be called ignorant, or else his honesty must be questioned. Most "breaks" can be prevented, but some cannot. Let us prevent those we can, and call the others hog cholera. That is what they are.

Under conditions existing in the United States during the last decade simultaneous treatment has been a great boon to the swine industry; it has saved hogs worth millions of dollars; it has made it possible for any breeder who will, to banish fear that hog cholera will destroy his herd. But in spite of these facts it is not perfect in its operation; it is sometimes instrumental in spreading the disease it is intended to check; it involves some dangers. These are best avoided when their causes are fully understood; best combated when they are frankly admitted to exist.

Forewarned is forearmed. Any veterinarian who contemplates using simultaneous treatment in a client's herd should tell him that it involves a little danger; that the herd must be carefully handled for about three weeks; that if a "break" should occur it must be reported promptly, and that under no circumstances are susceptible hogs

to come in contact with vaccinated ones during the four weeks following treatment. It is sometimes difficult to mention these things, without causing the dangers to be exaggerated in a client's mind, and some breeders will decide not to take risks which they would readily assume could they know how slight they really are. Nevertheless a veterinarian's first duty is to protect his client, and he must protect himself if he is to remain in practice. The man who glibly advises that there is "no danger" following *his* vaccinating is not doing either.

Summary of action of simultaneous treatment.

1. Produces an active permanent immunity in all hogs more than twelve weeks of age.
2. Produces active immunity in some suckling pigs, passive immunity in others.
3. Usually produces a very mild reaction beginning about five days following treatment, and lasting less than seven days.
4. In hogs with low resistance,¹ sometimes produces a severe reaction which exceptionally terminates in death.
5. Causes some hogs to eliminate hog cholera virus in their excretions during the time the reaction is in progress.

¹The terms "resistance" and "condition" should not be confused. The former, as used here, applies to the state of the animal's natural defenses against disease, and is determined by the history, as well as by the appearance of the animal. "Condition"

6. May cause abortion in pregnant sows, and may stunt pigs if they are treated while their resistance is low.

Simultaneous treatment is indicated in herds where hog cholera virus is almost sure to find its way sooner or later, but where actual infection of the herd may be delayed several weeks or months. Such conditions exist:

1. In sound herds on infected farms.
2. In other herds immediately threatened with cholera.
3. In some show hogs. See "handling show hogs" in Chapter IX.
4. On farms on which hog cholera has appeared periodically.

5. In very large herds in which there is constant exchange of animals.

6. In garbage-fed herds.

Simultaneous treatment is contra-indicated:

1. When it cannot be applied by experienced men.

2. When the entire herd cannot be immunized. (Some may, if necessary, receive serum alone, but none must be left susceptible.)

applies more specifically to the degree and quality of flesh an animal carries, as well as to the appearance of the coat, and is determined, in hogs, principally by inspection. Fat hogs recently shipped or fat sows that have recently farrowed, though in good condition, will not tolerate simultaneous treatment nearly as well as ordinary farm hogs in very moderate flesh. The "resistance" of the latter is higher, although their "condition" is lower.

3. When the treated herd cannot be properly segregated.

4. For sucking pigs as a routine measure. (Information still incomplete on this point.)

5. For sows about to farrow, or for those nursing young litters.

6. In badly infected herds.

7. In animals with low resistance due to shipping, weaning, castrating and other influences.

8. In all circumstances in which serum alone will be equally effective.

Follow-up treatment. This consists of giving serum alone and following it in a few weeks, usually less than four, with simultaneous treatment. It has been called "double treatment" by some, but according to usage which has now become fixed, the terms "double treatment" and "simultaneous treatment" are applied interchangeably to serum-virus administration. It therefore seems desirable to apply to serum alone followed by simultaneous treatment, the separate, distinct and self-explanatory term, "follow-up treatment."

Follow-up vaccination is safer than simultaneous treatment, it can be applied under circumstances which practically forbid the use of the latter method, and the final result is the same—a permanent immunity is established. There are those who believe that the passive immunity produced by the dose of serum alone prevents the re-

action and consequent permanent immunity due to subsequent serum-virus treatment. The impression seems to prevail that there is just one way to immunize a hog permanently, and that is to give him simultaneous treatment as a first and only measure. Various troubles following follow-up treatment have been cited as proof of this theory, but we have never investigated a case in which there was the least evidence that the system was fundamentally at fault. The trouble has been in its application.

In applying the follow-up system, there is a marked tendency for the veterinarian to give the dose of serum alone and to neglect for too long a time to follow it with simultaneous treatment. There is no danger in this unless the pigs happen to be exposed to cholera after the passive immunity due to the dose of serum has disappeared, but too often just that very thing takes place. The owner of the animals derives a false sense of security from the fact that serum has been administered, and hence does not report the sickness as promptly as he otherwise would. The final result is that when hog cholera is well started in the herd, the veterinarian receives an urgent call to give serum and virus as the final installment of the follow-up treatment. Heavy losses inevitably follow, and the entire system is condemned. It should always be remembered that serum alone

cannot be depended on to protect more than four weeks.

“Virus breaks” are no more likely to occur when follow-up treatment is administered than they are following simultaneous treatment, and, as with the latter method, their prevention consists wholly of giving full doses of virulent virus, and using due care not to treat pigs too young. When these precautions are observed, we can vouch for the fact that follow-up treatment produces a permanent immunity. We have used it since 1912 in maintaining many immune herds, usually administering the final dose, simultaneous treatment, when the pigs were about twelve weeks old. We have not had a “virus break” during the nine years the system has been employed; that is, no pigs that survived the immediate reaction following the final serum-virus treatment subsequently developed hog cholera. It is our custom to select hypers from these herds, and so far none of them have developed hog cholera as a result of hyperimmunization. In the East many veterinarians use the follow-up system in maintaining herds immune to cholera, and “virus breaks” are not common.

Experimentally we have tested the effects of giving follow-up treatment using various intervals between the time of administering serum alone and that of administering serum and virus,

and trying to smother the action of virus by large and repeated doses of serum alone previous to simultaneous treatment. In no case have we obtained evidence to justify even a suspicion that follow-up treatment does not produce permanent immunity, and we know of no experimental work that contradicts these results.

The factor of greater safety cannot well be questioned, although it is seldom that hogs with average resistance require follow-up treatment. Simultaneous immunization produces the same result, and is cheaper. But if exceedingly valuable animals are to be immunized, one cannot go amiss in giving a dose of serum alone and following it in a week or two with simultaneous treatment. If the first dose of serum is in the system, already absorbed, when the second dose is given with virus, there can be no question that the hazards are reduced. Exact comparisons of the safety of simultaneous and follow-up treatment are difficult to make, because under ordinary conditions both are nearly 100 per cent effective. We have seen follow-up treatment used in immunizing cattle against rinderpest with losses running less than 5 per cent when simultaneous treatment with the same serum and virus caused such heavy losses as to forbid its use altogether. We do not care to generalize too far on this point, but the principles employed in preparing and using the two se-

rum are the same, and we offer the observation for what it is worth.

Follow-up treatment is indicated:

1. For very valuable hogs where the greatest possible safety is required.

2. When the following conditions coexist in the same animal or herd:

A. Immediate protection is imperative.

B. Ultimate permanent immunity is desired.

C. Conditions render immediate simultaneous treatment dangerous.

Follow-up treatment is contra-indicated in all cases in which it appears that serum alone or simultaneous treatment will be equally effective.

It is in immunizing hogs with resistance obviously below normal, and in maintaining immune herds under somewhat adverse conditions that follow-up treatment renders greatest service. In practice, especially in the East, we constantly encounter the three conditions we have enumerated above, and follow-up immunization relieves us from the necessity of choosing between serum alone which will not produce a permanent immunity, and simultaneous treatment which is positively dangerous at the time when immediate protection is required. In a succeeding chapter the adaptations of follow-up treatment will receive further attention in connection with specific conditions which we meet in the field.

CHAPTER IX

HANDLING HOG CHOLERA IN THE FIELD

HANDLING hog cholera in the field requires application of the principles that have been outlined in preceding chapters. In this chapter our plan is to assume the existence of certain actual conditions which the practitioner frequently meets in the field, and to suggest methods of handling suited to these conditions. We know that in doing this we may invite criticism, for methods of handling hogs are so widely different in various parts of the country that one cannot supply details that will apply everywhere.

In some parts of the South, for instance, where hogs are allowed almost unlimited range, where predatory animals are common, where hog cholera is prevalent, and where a few breeders use simultaneous treatment regularly, others must protect their hogs in the same manner, or lose them. In certain sections of the corn-belt hog cholera is prevalent to such a degree that it is the part of wisdom for practically all breeders to maintain immune herds. In the East, where hogs are rather closely confined, where they are raised in limited

numbers, where hog cholera is not common and its spread is not rapid, most herds do not require immunization. Moreover, in the corn-belt where hog raising is a business, methods of swine husbandry are relatively much better than they are in sections in which it is a mere adjunct to other farming operations. The average corn-belt breeder has had more or less experience with hog cholera, he knows what it means to have it sweep unchecked through his herd, and he is not inclined to be dissatisfied with measures that will check it, even though these measures may not always be perfect in their operation. On the other hand, the Eastern breeder whose herd we are called on to handle very often is having his first experience with the disease, he is inclined to be skeptical as to the merits of protective serum, and to doubt its value if he loses a few animals after it has been administered. Frequently also, the herd is found in unthrifty condition due to poor methods of swine husbandry and heavy parasitic infestation. Virus cannot be used as freely in such surroundings as it can under circumstances where its effects will be more correctly judged.

Despite these differences, though, and despite the fact that methods of swine husbandry have a direct and important bearing on the handling of disease, the principle holds that hog cholera is hog cholera the country over, and not, as some

would have us believe, different according to the section of the country in which we chance to find it. The differences we observe in various parts of the country are due principally to prevailing secondary invaders, as well as to variation in virulence of the hog cholera virus itself, for they are observed also in comparing individual herds or outbreaks in any one section.

While we must accept all these variations and allow for them, the underlying principles employed in handling hog cholera remain unchanged, and it is desirable and necessary in a treatise of this kind to suggest definite working plans, leaving the reader to alter or supply detail as individual cases warrant. We are moved to do this because we have seen young graduates of veterinary colleges who had had good instruction and whose technique in administering serum left little to be desired—we have seen some of these men practically helpless in the presence of outbreaks of cholera which presented disturbing but not unusual features. Likewise men who are accustomed to the routine of vaccinating thousands of stockyard hogs are sometimes confused when they are called on to accept the conditions they meet on the average farm, to prescribe treatment for a mixed lot of swine, and guide the breeder away from future trouble. Mere knowledge of how to vaccinate hogs does not equip one to handle hog

cholera; diagnosis, when and whether to vaccinate, the method to use, and the subsequent handling of the herd all enter into the problem.

Handling the cholera infected herd. Let us assume, as a working basis, that a herd consisting originally of one hundred ordinary shoats, in good condition, is infected with hog cholera; ten have died, ten are visibly sick, and there is no evidence of secondary infection; there are no other hogs on the farm, and the shoats are in a pasture containing several acres; the owner has had hog cholera in his herd in previous years, and knows the results that may reasonably be expected from preventive measures. This represents the simplest situation we are called on to cope with in handling hog cholera in the field.

Three methods of handling are open to us:

1. Give generous doses of serum alone to all animals that are not exceedingly weak.
2. Give simultaneous treatment to all seemingly well animals, and double doses of serum alone to those that are visibly sick, and not obviously near death.
3. Give serum alone in full doses to all animals that are apparently well, in double doses to those that are sick and have a chance to recover, and follow this in three weeks with simultaneous treatment for all animals that were not visibly sick at the time of the first treatment. In other

words, give serum alone to the sick animals, follow-up treatment to those that are apparently well.

Regardless of the method selected, we must proceed promptly with the one that becomes our final choice, and we must take immediate precautions to prevent spread of the disease to other herds.

Method number one may prove highly satisfactory in some cases of this kind, but it is open to the serious objection that it may not produce permanent immunity in all the animals. In the individual, serum alone plus hog cholera infection produces permanent immunity, but in a herd of this kind, although all the animals are *exposed*, some may not become *infected* in time to secure this result, because hog cholera does not always spread rapidly through herds that are at pasture or in other large runs.

Let us select, as an instance, one shoat in the herd and assume that the animal has received serum alone to-day. If in the course of the next three or four weeks—the usual duration of immunity due to serum alone—it chances to take up virus sufficient to infect, it will undergo a reaction and thereafter be permanently immune to hog cholera; but if the event of infection is delayed much longer, it will find the animal susceptible to the disease. In other words, if infection takes

place while passive immunity due to serum alone still exists, a permanent immunity is acquired; if it takes place after the passive immunity disappears, the animal will readily contract hog cholera; and, except where hogs are quite closely confined, chance alone must decide whether any particular individual will become permanently immune, or, failing in this, eventually die of hog cholera.

Method number two will produce more reliable results. The sick are distinguished from the well by physical appearance and temperature readings. In handling herds in this manner it is our custom to give serum alone to all animals showing temperatures above 104° F., and to all visibly sick, and not at the point of death, regardless of temperature reading. If, however, the weather is warm, and if the hogs are excited in handling, most temperatures will rise above this point, and the thermometer gives us very little information. Under such circumstances physical appearance is our only guide. A useful practice, whenever conditions are such that it can be employed, is to feed the hogs a little grain and to place those that leave the feed in a few moments among the sick that are to receive serum alone, and those that remain for a longer time and eat greedily, among the well that are to receive serum and virus. Practically all will eat a little, but the infected animals are

first to leave their feed. Any method of distinguishing the sick from the well is only approximately correct, but a herd handled in the manner we have outlined will emerge from the treatment permanently immune to hog cholera. On the whole, this method of handling is quite satisfactory, but it is open to the objection that we may introduce a more virulent strain of virus into herds already infected, and we may be accused of killing animals when we have merely failed to prevent their death.

This method is practicable only when the owner of the animals fully realizes that some apparently well hogs in infected herds will die following even serum alone administration, and when he is disposed to expect like losses following serum-virus treatment. Veterinarians experienced in handling hog cholera dread to use virus in infected herds, but we meet conditions under which it is wise to do so.

Method number three is safest, and, as with method number two, the herd emerges with all animals permanently immune to hog cholera. The added expense is the only objection, but in many instances, especially when the animals are above average in value, it is more than justified. There is great satisfaction to the practitioner, as well as to the breeder, in knowing that nothing has been

done to add fuel to the flames, and in being allowed three weeks' respite in which to observe the progress of an outbreak.

Irrespective of the plan we choose, if new cases continue to appear later than the sixth or seventh day following treatment, a second dose of serum alone is indicated; and if "breaks" occur subsequent to simultaneous treatment, they should be handled in the manner described in the preceding chapter.

Under the conditions in which we found this herd of shoats, we explain the situation to the breeder, and recommend method number three as safest, informing him at the same time that method number two is, in the majority of cases, satisfactory. With the facts before him he can then decide for himself.

Precautions to prevent spread of hog cholera to neighboring farms include preventing sale or exchange of sick or well animals from the infected herd, exclusion from the infected pasture of all persons, vehicles, or animals that may later enter non-infected hog quarters, and prompt disposal of carcasses so that they will not attract carrion-eating animals or birds. Burning is by far the best method of destroying carcasses, but burying in quicklime, or rendering, is permissible. In a pasture such as we find this herd of shoats dis-

infectants are of little service, and we must depend on natural influences (drying and sunlight) to destroy virus which contaminates the soil.

Many states have specific regulations governing precautions against interherd spread of hog cholera, and when these are available and practicable they should be followed. None of the shoats should be removed earlier than thirty days following disappearance of all sickness from the herd, and previous to their removal, if they are to mingle with cholera susceptible hogs they should first be dipped or sprayed with 3 per cent compound cresol solution. It is legal in some states, in handling a herd of this kind, to remove apparently well animals for immediate slaughter under inspection, but except in unusual circumstances the practice has little to recommend it.

If we go back to our original problem and assume alterations in the conditions there outlined, corresponding changes in the plan of handling will suggest themselves, and the reasons for these changes will appear. If hogs are closely confined and the herd is badly infected, serum alone is indicated, because natural infection will take place and produce permanent immunity in all that survive; if they are found under conditions that suggest low resistance, if they are of exceptional value, or if the owner is skeptical, nervous, or overcritical, plan number three should be recom-

mended, special care being taken to build up the resistance of the animals during the interval between serum alone and serum-virus administration.

If, as is sometimes the case, we are compelled to make a provisional diagnosis of hog cholera, we should give serum alone and observe the future development of the disease. Provided it proves to be hog cholera, or if it disappears entirely so that doubt still remains, we may give simultaneous treatment three or four weeks later; if it proves to be some other malady, and if hog cholera is not in the vicinity, simultaneous treatment should not follow unless the owner wishes to maintain an immune herd. Usually, when there is hog cholera together with some active complication, the immunity of the herd should be maintained on serum alone until the animals are in fit condition to receive serum-virus treatment. This may require two or more doses of serum at three or four week intervals, but if the complication is of such nature that it cannot be controlled after serum alone is administered, we will only aggravate it if we give simultaneous treatment.

Methods of preventing spread of hog cholera to neighboring herds are also somewhat different when we find the infected animals closely confined. We gain very little by cleaning and disinfecting quarters occupied by hogs sick with cholera, be-

cause each time an infected animal urinates, reinfection of its pen takes place. As long as hog cholera is active in a herd we should devote our attention to effective quarantine, prompt disposal of carcasses, and the maintenance of ordinary cleanliness that is at all times conducive to the health of the animals. When the disease disappears, all contaminated litter should be burned, and the indoor quarters sprayed with 3 per cent lysol or compound cresol solution. Often application of disinfectant at intervals of several days is advantageous. Hog cholera virus cannot always be killed in outside yards. Spreading a thick layer of straw over the yard and burning it is probably most effective, but this is not always practicable. Plowing and free use of disinfectants hasten destruction of the virus, but the latter measure is useful only in small enclosures.

Too often directions given for disinfecting quarters require more than is possible, and they are not specific. If we are careful not to require unnecessary and laborious measures we will secure much better coöperation in carrying out those that actually are essential; and if surroundings are such that we find it impossible to give detailed and specific directions for cleaning and disinfecting, we may be sure that the general admonition to "clean and disinfect" will do very little good. We must recognize the fact that some hog quarters cannot

at once be freed of hog cholera virus, at least by methods within reach of the man of average means. Under such circumstances, if hog raising is to be continued, the herd should be maintained immune to hog cholera.

We have already said that handling a herd of infected shoats is the veterinarian's simplest duty in dealing with hog cholera. We will now consider some of the more complex problems that field work constantly place before us. Let us suppose that in addition to the herd of infected shoats there is on the same farm, some distance away, a number of feeding hogs that have shown no signs of disease. If the animals are to be marketed in less than four weeks they may receive serum alone, and if hog cholera does not appear among them in the course of six or seven days, it is allowable to kill them under inspection; if marketing must be delayed more than four weeks, simultaneous treatment is indicated. As far as the effect of treatment itself is concerned, hogs may, if emergency demands it, be killed for food as early as one day following administration of serum alone, but if serum and virus are given, a delay of at least three weeks is desirable.

In addition to feeders we encounter on practically every farm a considerable number of breeding stock. A boar, pregnant sows, some just farrowing, and others nursing litters make up the repre-

sentative farm herd. A permanent immunity is desired for all of these, and we follow the general plan of giving simultaneous treatment to all animals in condition to receive it, and protecting the others with serum alone pending the time when they may safely receive serum and virus.

Assuming that breeding stock of this character is on the farm with the infected shoats, but that after numerous temperatures have been taken there is no evidence of disease, it may be handled as follows: the boar may be given serum and virus at once, or if he is of exceptional value, follow-up treatment; sows in early pregnancy may be handled in the same manner, but always after the breeder has been informed that simultaneous treatment will sometimes produce abortion, and that the slight danger must be accepted as a lesser evil; sows due to farrow in less than three weeks and those that have pigs a few hours or days old cannot safely receive virus. It is true that the infection on the farm will in most cases ultimately reach them, but our aim should be to delay this as long as possible, and to protect the sows with serum alone in the meantime. Continued isolation of the sows is desirable. Two or even three doses of serum alone at three or four-week intervals may be required before the time is ripe for the final simultaneous treatment, but the extra expense is greatly to be preferred to the alternative

—that of using simultaneous treatment so that the sow will be farrowing or nursing a newborn litter at a time when the resulting reaction is in progress.

The pigs likewise should be maintained on doses of serum alone at four-week intervals until they are at least nine weeks old, preferably twelve, and then they should receive simultaneous treatment. If they are fairly well isolated from the infected animals the first dose of serum alone may be delayed until they are two or three weeks of age, otherwise it should be given when they are only a few days old.¹

¹The question whether young pigs acquire a permanent immunity as a result of simultaneous treatment is yet unanswered. Niles describes experiments indicating that they do, while Cahill on the other hand found that over 50 per cent of several hundred pigs given serum and virus between the ages of two and eight weeks failed to acquire a permanent immunity as a result. Petersen found that only fifteen out of one thousand "baby pigs" given simultaneous treatment proved susceptible as old hogs. We have collected very little experimental data on this point, the results agreeing substantially with those of Niles.

Our field observations, however, lead us to believe that a permanent immunity is not always established when serum and virus are given to sucking pigs. In one instance we gave simultaneous treatment to fifty pigs that were about eight weeks old. When the animals had reached a weight of about 150 pounds, one of them was brought to us for autopsy and showed undoubted lesions of hog cholera. Three or four of the others developed symptoms of the disease during the following week, so the entire herd was revaccinated. Two of those that sickened died later but we did not have an opportunity to perform autopsies. There is little doubt that they died of hog cholera, but just how many more would have died in the absence of a second injection is a matter of conjecture. In another instance that came under our observation about eighty young pigs were given simultaneous treatment, and when these animals reached a weight of about 180 pounds each, approximately twenty of them died. We performed autopsies on several, and found unmistakable hog cholera lesions.

We have been called on repeatedly to handle herds of sows infected with hog cholera just at farrowing time. Whenever it is possible we dip the animals, segregate them as best we can and administer serum alone, carrying both sows and pigs along with doses of serum alone at four-week intervals until the latter are weaned and at least nine weeks old, at which time sows and pigs receive simultaneous treatment. In herds in which isolation is impossible, we follow the same course in regard to administering serum, giving the first dose, about 4 mils, when the pigs are a day or two old. It is possible to bring pigs safely

These observations do not carry the weight that may be attached to carefully controlled experiments, but they suggest caution in regard to the sweeping conclusion that all young pigs acquire permanent immunity as a result of simultaneous treatment.

Closely bound up with this question is the one of the immunity of sucking pigs to hog cholera. Pickens found that 100 per cent of pigs nursed by immune mothers were themselves immune, but any person with extensive experience in handling hog cholera knows that we cannot always, or usually, depend on this immunity. We have repeatedly seen pigs born of immune mothers and nursed by them dead with hog cholera before they were four weeks old, but there are others, as Pickens' experiments show, that are immune.

Collectively, all experimental work and clinical observations so far recorded point to the conclusion that some pigs of cholera immune mothers are themselves immune, and others are not; some will acquire active immunity as a result of simultaneous treatment, others will not. We have no way of knowing whether any particular young pig or litter will acquire permanent immunity if simultaneous treatment is given, so we prefer to maintain the immunity of all young pigs with serum alone, and to finish with simultaneous treatment when the animals are about twelve weeks old. A cheaper plan than this will be available in well-kept herds if the findings of Niles are confirmed; a more effective one is not likely to be found as long as we use serum and virus as they are now prepared.

through an outbreak even when they are born in pens containing hogs sick with cholera, and this presents no great difficulties when the sows are immune, but when farrowing and recently farrowed sows are susceptible, they do not tolerate virus well. Despite the fact that they receive serum a few will die, other will fail to nurse their litters, and on the whole results are much less satisfactory than they are when reasonably effective isolation can be practiced.

We do not wish to convey the impression that after hog cholera reaches a herd we can prevent, by isolation, ultimate infection of all the animals in it for exactly the reverse is true. The point we emphasize is that when the disease appears among sows that are farrowing, infection of many of them can be *delayed* by isolation, that they gain valuable time, and they and their litters are in better condition to withstand the effects of the virus when later it reaches them, either by natural means or through simultaneous treatment. A sow undergoing serum-virus reaction when her litter is a day or two old is in some danger of death, and even if she lives lactation may cease and her pigs perish. Delay the event of infection four weeks, and regardless of how it affects the sow the litter can be saved. The theoretical grounds for handling farrowing sows in this manner are obvious, but we recommend the plan of

isolation only because repeated trials have proved it effective.

Establishing and maintaining a hog cholera immune herd. So far we have dealt with hog cholera after it has reached the herd. We are now to consider methods of preventing it from infecting the herd, which yield even better results. In their relation to the prevention of hog cholera, most herds fall into three general classes: those from which the virus can be excluded; those constantly threatened with hog cholera; and pure-bred herds from which immune breeding stock is sold. The herds in the first class do not require immunization; those in the other two classes are best maintained immune.

The first question to be decided when a client consults his veterinarian is whether it is really necessary for the herd to be maintained immune. Is hog cholera prevalent in the vicinity? Has it appeared periodically on the farm in question? Is the herd subsisting partially or wholly on garbage? Is the breeder buying in hogs at frequent intervals? Does he take sows to neighboring farms to be bred, or are sows brought to his farm for the same purpose? Has he an established market for immune breeding stock, or does he wish to establish one? Has the herd access to a stream that may be contaminated with hog cholera virus? If all these questions can be answered

in the negative we should advise the breeder not to immunize. It is an unnecessary expense, and when once simultaneous treatment is employed in a herd there is some danger in discontinuing its use. Pigs thus immunized may eliminate virus, and this may be on hand to infect susceptible animals that subsequently are added to the herd by birth or purchase. In case it is desired to discontinue immunization, at least four months, and preferably six, should elapse between the date when simultaneous treatment is last used on the place, and that of the introduction of susceptible recruits into the herd. All of these facts should be perfectly clear to the breeder before virus is used in his herd.

When chances of infection with hog cholera are remote, and the breeder is advised against maintaining an immune herd, he should be cautioned against all the practices that may result in the infection of his swine. He should also be informed regarding the things that would lead him to suspect the presence of hog cholera, and the necessity for early reporting of an outbreak, should it occur, must be made plain.

When hog cholera threatens ultimately to attack a herd and destroy it we can render the breeder no greater service than in advising him to maintain it immune to cholera. Much as we dislike the idea, in the abstract, of introducing virus into

new territory, our experience in concrete cases is that one untreated cholera infected herd in a neighborhood is more of a menace to adjacent herds than ten properly maintained immune with simultaneous treatment. In the untreated, infected herd, there is a great temptation sometimes to sell animals before a diagnosis of cholera is made, some breeders are slow to accept the fact that hog cholera is in their herds, and on the whole the attack comes on unheralded, and much damage is done before its true nature is realized. On the other hand, when we administer simultaneous treatment to a herd we deliberately establish our defenses against the spread of hog cholera that may possibly result from it, the period of acute danger is quickly passed, and the herd is no longer a menace to others in the vicinity.

When once the breeder decides to maintain his herd immune to cholera, the practice must be faithfully carried out. Between keeping all animals immune to cholera at all times and declining to use any virus whatever, there is no middle ground. We cannot temporize with a disease like hog cholera. Like the proverbial nettle, simultaneous treatment incident to maintaining a cholera-immune herd must be grasped firmly or avoided altogether, for it will not do to have virus and susceptible pigs in the herd at alternate intervals. Sooner or later the two will get together.

Let us suppose that a breeder of pure-bred hogs wishes to establish a trade for immune breeding animals, and has decided to maintain a cholera immune herd. His herd consists of two large herd boars, fifty brood sows nursing litters about four weeks old, fifty gilts recently bred and now being sold daily in twos and threes as the trade demands, and a herd of one hundred fattening hogs that will be ready for market in six weeks. Hog cholera is not threatening the herd. How is it to be handled with the greatest safety, and with the least expense and inconvenience?

The brood sows are not in the best condition to receive simultaneous treatment, the gilts could not be sold and shipped at once if it were given, and the fattening hogs will be sold anyhow in six weeks. If we wait that length of time the gilts also will be sold, the young litters will be weaned, and sows and pigs will be in condition to receive simultaneous treatment. The two boars are thus the only animals in the herd for which the delay of six weeks is not positively indicated, and they can be immunized as well at one time as another.

From this concrete example we develop the simple rule that when choice is allowed we begin immunizing at a time when the herd is at a minimum as far as numbers of adult breeding stock is concerned, and when the animals are in condition to receive simultaneous treatment with the least pos-

sible risk. In the average farm herd the most opportune time to immunize is three or four weeks after the spring litters are weaned.

On the other hand, when the herd is immediately threatened with hog cholera we have no choice but to accept it as it is, and protect it at once. Under such circumstances the plan is to give simultaneous treatment to all animals in condition to receive it, and serum alone to the remainder. Every four weeks we return and repeat the process, confining the treatment to those that received serum alone previously, until the entire herd has received simultaneous treatment, and permanent immunity has thus been established.

When once the adult breeding stock is immune, our task is then to immunize the young litters as they come on. This is relatively simple for the veterinarian and inexpensive for the breeder. On farms where methods of swine husbandry are the best, and at times when there appears to be little immediate danger from hog cholera, the best plan is to keep close watch on the pigs until they are about twelve weeks old and then give simultaneous treatment. In many herds though, especially the large garbage-fed herds in the East, a high percentage of the pigs will, if left unprotected, contract hog cholera before they reach an age approaching twelve weeks, and a considerable number that do not actually contract the disease

will fail to develop so as to be fit subjects for simultaneous treatment. In these herds, the only effective plan we know of is to protect the pigs with serum alone until they are old enough and in proper condition to receive serum and virus. Under ordinary conditions the pigs receive serum alone when they are between three and six weeks of age, they are weaned when they are about eight weeks old and receive simultaneous treatment two to four weeks later. It is best to castrate them as sucklings. Under exceptional conditions we are compelled to give more than one dose of serum alone before the time is ripe for simultaneous treatment, but an extra dose of serum for a small pig is not expensive.

We have used this general plan since 1912, starting with several garbage-fed and cholera infected herds in quarters that did not permit cleaning and disinfecting, and protecting all subsequent litters of pigs, year after year, with losses from all causes totaling considerably less than five per cent. We know of several other veterinarians who have obtained like results during a term of years, and we do not know of a single instance where the plan has been followed consistently and found wanting. The preliminary doses of serum alone are not necessary in all herds, but we may resort to them confidently under conditions such as we have described.

Several points that contribute to the success of maintaining an immune herd remain to be mentioned. Especially in large herds it is a good practice to mark each pig at the time it is immunized so that it can be positively identified. Otherwise we are likely to miss an occasional pig or litter, and if these untreated animals subsequently contract hog cholera, we are called to account for deaths for which we are in no way responsible. We should also suggest to the breeder the advantage of breeding several sows near the same time, so that a considerable number of pigs can be immunized at one time. In addition to economy in immunizing this practice enables the breeder to provide foster mothers for pigs farrowed by sows which on account of death or disease incident to parturition are unable to nurse their litters.

It is important that pigs shall grow steadily and rapidly from birth until the time when simultaneous treatment is administered. Influences that retard growth usually lower resistance as well and we are thus compelled to maintain the immunity of poorly nourished pigs with serum alone much longer than is necessary in handling thrifty pigs. Any suggestions that will aid the breeder to grow pigs rapidly during the first three months of their lives will be greatly to his advantage.

Handling feeding hogs. A common practice on farms in many parts of the country, more par-

ticularly in the corn-belt, is that of purchasing feeding shoats in the fall of the year to consume the season's crop of grain. The general tendency is for these shoats to be raised in regions where land is rather cheap, and fattened in localities where higher-priced land compels a more intensive type of farming. Direct communication between the breeders who raise the shoats and the feeders who finish them is not generally maintained. The breeder seeks a seller's market in cities where there are large stockyards, and the feeder habitually goes to these places to buy. Before the discovery of anti-hog-cholera serum, long years of bitter experience had taught feeders that hogs which pass through large public stockyards very often contract cholera. As soon as the serum was discovered it was eagerly seized on in attempts to protect stockyard shoats that subsequently were to be shipped to other farms to be fattened. The desire was to give these animals permanent immunity to hog cholera, so it grew to be a general practice to administer simultaneous treatment to them in the yards, and ship them in the course of a few days to the feeder's farm. Years of experience prove that this practice, though perhaps an improvement over old methods, is frequently the cause of heavy losses, both in the immediate animals treated and in hogs

with which they come in contact after they reach their various destinations.

Those who follow the practice are merely lucky if they do not sustain heavy losses because they continually ignore the fact that a reaction normally follows simultaneous treatment, and that shipping lowers the resistance of hogs to such an extent that the reaction may prove fatal. When we add to the effects of shipping and simultaneous treatment those incident to a brief or prolonged stay in infected yards before the treatment is administered, as well as those that grow out of injudicious feeding and watering when the animals reach the end of a journey, fatigued, hungry, and thirsty, we have a chain of devitalizing influences that often cause disaster.

It is well known also that many swine unloaded at stockyards do not leave home free from disease. Oftentimes a consignment of hogs represents a breeder's final determination to "cash in" on a herd that is badly infested with parasites, that is suffering with some obscure respiratory disease, or one that has recently contracted hog cholera. Despite the fact that apparently well animals are selected from such herds for shipping each animal selected is potentially the source of future trouble. What is one to expect if in purchasing hogs for the feed-yard he chances to include even a few individuals of this kind? The

mere fact that many lots of shoats are shipped long distances to stockyards and after receiving simultaneous treatment are at once reconsigned to distant localities which they reach without immediate or subsequent mishap has little bearing on the problem as a whole. It is the fact that many lots of hogs will not endure such handling, and that we cannot always distinguish in advance between those that will and those that will not, that still troubles us. This aspect of the subject will receive further attention in the chapter on "The Control and Eradication of Hog Cholera."

Let us assume that a man living in western New York requires two hundred shoats as feeders. His natural purchaser's market is in the stockyards at Buffalo, or further west in the hog-raising districts of Ohio. He knows that there are certain dangers connected with shipping hogs and he consults his veterinarian in order to learn how they can be avoided. What precautions should he be advised to take?

Other things being equal it is best to purchase direct from the farm, for this avoids unloading animals at large stockyards, and it is much easier to determine the true condition of hogs when we examine them in what may be termed their normal habitat than when we inspect them hurriedly during the excitement and confusion that prevails at the average stockyard. If immune feeders can

be purchased from a reliable source on the farm, that is by far the most satisfactory plan. In case that is impossible, our client should be advised to purchase from thrifty farm herds and to assemble the animals on a stated day at a local shipping point. They should then be given serum alone, placed in clean comfortable well-bedded cars, and shipped at once to their destination. When they arrive at the feeder's farm, they should be placed in dry comfortable quarters and fed sparingly on light foods for a few days. After they become accustomed to the change in feed and quarters—say in two or three weeks—they should be given simultaneous treatment.

If circumstances compel our client to purchase at the stockyards, he should if possible see the animals unloaded, and in any event he should not select animals that have been in the yards several days. It is best to avoid mixed lots of hogs, and those that contain a considerable number of dead animals when they arrive at the yards, for these often are shipped to market because of disease. Hogs that cough persistently should not be accepted. When once the selection is made the animals should be given serum alone without delay and shipped at once to their destination. When they arrive at the feeder's yards they require handling similar to that accorded animals purchased directly from the farm.

Careful and experienced men can usually select satisfactory feeders in large stockyards, but on the whole there are unavoidable risks associated with the practice.

Handling show hogs. Show hogs constitute a separate problem in themselves, because they are of exceptional value, and because they must necessarily be subjected to handling entirely different from that accorded the ordinary farm or market hog. It is not uncommon for show hogs to contract cholera during contact with other swine in the show ring or in transit from fair to fair, and not infrequently they arrive home apparently well, and develop symptoms of the disease during the few days following, thus infecting the entire herd which they represent. This experience has been so common that the practice of showing hogs that are not immune to cholera is indefensible. Some fair associations require certificates to the effect that hogs are immune to cholera before they will admit them to the show ring.

The breeder who maintains his herd immune to cholera has no difficulties to face from this quarter, for as far as hog cholera is concerned, he may send his animals out on the fair circuit secure in the knowledge that they will not themselves become infected, nor be instrumental in infecting others with which they come in contact.

The breeder whose herd is susceptible to cholera

must have his show hogs simultaneously treated at least thirty days before they leave for the fairs, or else he must give them serum alone at the time they start, and repeat the treatment at three-week intervals as long as they are on the road. Neither plan is entirely free from objection, but either is far from better than to neglect immunizing. If simultaneous treatment is given this necessitates the introduction of virus on a farm where there are untreated susceptible hogs, and thus it is applicable only where there are facilities for effective segregation of the show hogs. If serum alone is given and the hogs are infected with cholera at the fairs they must pass through the resulting reaction at a time when they are low in resistance, and if the reaction is so severe that it results in virus excretion, there is danger that in returning from the fair circuit the show hogs may infect the home herd.

If simultaneous treatment is to be given show animals and the remainder of the herd is to remain susceptible to cholera, the following plan is safest: isolate the show hogs in quarters that will permit subsequent disinfection and give them serum and virus; if during the next thirty days none of the animals develop visible sickness, dip or spray them thoroughly, using 3 per cent compound cresol solution, and send them out on the show circuit; when they return, it is best to dip

them a second time before they are placed with susceptible hogs, and where there are facilities for isolating them two weeks after they return this should be done as an additional precaution. We must not lose sight of the fact that even an immune hog can become the intermediate carrier of hog cholera virus.

Should a "break" appear when the show hogs are immunized it should be handled according to the plan previously outlined, and as an additional precaution, the entire herd had best be protected with serum. In any event, when the hogs leave the quarters in which they are placed for simultaneous treatment, the pens should be carefully disinfected.

When no virus is to be used in treating the show animals they require serum alone at the time they leave home, and thereafter every three weeks as long as they are on the road. After they return it is well to isolate them two weeks, after which they may be dipped in antiseptic solution and placed with the remainder of the herd.

On the whole, a breeder who habitually places hogs in the show ring should maintain his entire herd immune to hog cholera. Under most circumstances, when this is not done the use of serum alone for temporary protection is indicated, but under exceptional conditions, where perfect segregation is possible simultaneous treatment may

be given the show animals. Not infrequently the practitioner has the question of immunization thrust on him as an eleventh-hour consideration just on the eve of the departure of show hogs for the fairs. In this event he has no legitimate choice but to protect the animals with serum alone during the period of probable exposure.

ORDERING SERUM

Every veterinarian in country practice is likely sooner or later to be called on to immunize swine against hog cholera, and because much immunizing consists of emergency work, serum must be procured without delay. For this reason the veterinarian should establish relations with a reputable laboratory near at hand so that telegraphic orders from him will be filled promptly. Because they cannot assume responsibility for products that have been in other hands, most laboratories will not allow credit for returned serum and virus and thus it is desirable to order the exact quantities required.

Before ordering serum the veterinarian should ascertain the number of hogs to be vaccinated, and their approximate weights. A representative list would appear thus:

1 boar,	weight	600 pounds
8 sows,	weight	400 pounds each
65 pigs,	weight	20 pounds each
50 shoats,	weight	60 pounds each

The common tendency is to estimate weights of swine far too low, and this should be thought of in connection with every serum order.

Before the list is completed the final question, "Have you any other hogs?" should always be asked, for it is very annoying and very common to find, even after we reach a farm to do the immunizing, that the owner has hogs which he has not mentioned because he "hadn't thought of having them immunized." If a simultaneous treatment is to be given to any of the hogs in a herd, the remainder must not go long without some kind of immunization, and lack of sufficient serum to treat an entire herd may often postpone the date of treatment or necessitate a second call.

When all of the hogs that are in the herd are listed, the veterinarian can estimate the quantity of serum and virus required, provided he has a dose table from the laboratory he patronizes. Lacking this, he should send in the list and allow the laboratory to make the estimate.

Telegrams or letters containing orders such as "Serum and virus for 20 swine" or "Serum to treat a mixed bunch of 100 sows, pigs and shoats" are not sufficient. Every order should state the required quantity of each product, or it should include a list of the number of hogs and their approximate weights.

Most field work falls within the scope of the concrete instances outlined in this chapter, but it is necessary, as we endeavored to make clear in the beginning, for one who handles hog cholera to *understand hog cholera*. Our aim throughout has been to show why as well as what, but if we have fallen short of this aim we can at least assure our readers that the methods recommended are conservative and effective, and that they have been developed as a result of years of field and laboratory experience.

One final thought. The beginner in hog cholera work sooner or later finds himself face to face with some baffling situation. A herd seems in need of immediate protection but doubt in regard to diagnosis, doubt as to whether the complete history of the herd has been frankly laid before him, and the question whether complete coöperation will be accorded him in the subsequent handling of the herd, render selection of the method of immunizing difficult to make. "*When in doubt and emergency requires immediate protection of a herd, use serum alone; then follow with simultaneous treatment in less than four weeks if subsequent development of the disease requires it*" is the final caution we leave with the beginner.

The Veterinarian's Charge for Serum and Its Administration

If a veterinarian expects to remain long in practice he must render service worth much more than the charge he attaches to it, and the benefit derived from his calls must be obvious to his clients. The fact that immunization of hogs, especially large herds in localities where hog cholera is prevalent, results in a great and obvious saving to the breeder has placed this phase of veterinary practice almost in a class by itself. We do not actually render a greater service in checking an outbreak of hog cholera than we do in eradicating tuberculosis from a cattle breeder's herd, but hog cholera is an acute and fatal disease and the direct saving due to its control is far more apparent to the breeder than some other services, equally as valuable, that we render him. Because of this fact, and because of the great demand that has existed for the services for veterinarians in immunizing swine, certain abuses in regard to charges for serum administration have come to light. Complaints have been leveled at a few shortsighted and greedy individuals, but they have reacted to the discredit of the profession as a whole. Especially when large numbers of hogs are vaccinated in one day, when charge is made by the head, and a profit greater than is fair is added

to the serum used, the veterinarian goes home leaving his client believing that he, and other members of the profession, are shameless profiteers. The natural inference is that other professional charges as well are exorbitant, and this, as all veterinary practitioners know, is not true.

When immunization of a herd of hogs is really indicated and when a veterinarian does the work thoroughly and conscientiously, he renders a great and obvious service, and is entitled to a fee considerably above that which the average breeder is inclined to regard as fair. The breeder would be surprised if he knew the cost of waste, breakage, and overhead which the veterinarian must pay. We believe though, that instead of courageously charging fees which are actually their due, and which will enable them to use first-class products and do careful work, too many veterinarians have yielded to a temptation to collect their fees, unknown to the breeder, in the form of profit on the serum used. The purchase price of the serum sooner or later comes to light and in the absence of previous explanation, the breeder naturally believes that the difference between the price the veterinarian pays and the price he charges his clients for serum is all profit. Real and imaginary abuses in this direction have led to actual and proposed legislation designed, on the one hand, to place vaccination of hogs largely in the hands

of laymen, and on the other hand to fix the margin of profit which the veterinarian may charge, or at least to prevent him from concealing from his client the purchase price of the serum he uses.

Legislation of the former type can result only in disaster to the swine industry and harm to the veterinary profession, but we do not believe there are good reasons why the purchase price of serum should not be known to the breeder. Obviously the profession puts itself in a bad light when it opposes legislation of this kind, unless it can justly be opposed on the ground that the handling charge proposed is not sufficient to cover costs of waste and breakage. Such opposition only gives substance to the suspicion that there is something to conceal. It is a principle which should be obvious to all that if the veterinary profession is to retain exclusive rights to administer serum and virus it must exercise these rights in a manner to justify this exclusion; and any legislative attempts to discipline the occasional renegade who habitually reaps an excessive profit on serum should, and we believe will be, welcomed by the better element in the veterinary profession.

The veterinarian's fee for his work is his own private concern, and the compensation he can command depends for the most part on the skill and knowledge which he employs to benefit his client; but the best interests of the public demand that the

use of serum and virus shall be placed exclusively in his hands, and when this is done he has not the same right to fix the selling price of these products that he has to name his own fee. Use of serum and virus is a public trust reposed in him rather than a monopoly given into his hands for private exploitation. His profits should come from his work, not from the serum he uses.

Some practitioners charge according to the number of hogs treated, some according to the quantity of serum injected, and others on the basis that they fix fees for other calls. No system is entirely free from objection, but we believe that the most satisfactory and fair plan is for the veterinarian to place a value on his day's work and charge for vaccinating according to the time consumed in doing it. He is entitled to add to this a handling charge on the serum he uses, to compensate for clerical work, express, breakage, and unused products that are left on his hands. Under ordinary conditions, if breeders pay cash, an increase of 20 or 25 per cent over the purchase price will take care of these items, but it will not be sufficient if credit is habitually allowed. A practitioner can lose more on one bad serum bill than he can collect as fees for several days' work.

The practice of charging according to the time consumed has obvious advantages if we let our clients know that we are following it. It con-

sumes less time to vaccinate a given number of hogs for a client who will have the animals securely penned in clean dry quarters, and plenty of help ready for work when the veterinarian arrives, than it does to vaccinate one-fourth that number for a man who awaits the veterinarian's arrival and then begins a frantic or leisurely search for gates, lumber, ropes, and other needed paraphernalia. A veterinarian cannot consume several hours in vaccinating a small lot of pigs and at the same time keep his fee at a figure that the breeder can afford to pay. The breeder who provides facilities and help so that the work may be done dexterously and rapidly should profit by his foresight; the one who is neglectful must expect to pay for his negligence.

Emergency hog cholera practice, that is, the care of herds already infected, will come regularly to a man who handles it with only a fair degree of effectiveness. Under such circumstances even average veterinary service is far better than none. The same rule does not apply in maintaining immune herds, the phase of hog cholera control that offers greatest satisfaction to both practitioner and breeder. If the breeding in a herd is so ordered that a large number of pigs can be vaccinated at one time, if the animals are grown rapidly and conditioned so that they will withstand simultaneous treatment at an early age, and if the

breeder habitually provides facilities that allow vaccinating to be done without loss of time, the cost per head can be kept at a minimum. The veterinarian who so advises his clients as to bring these things about is the only one who can hope to enlarge his swine practice and gain lasting success in hog cholera work. A system of wireless which we do not completely understand, but which nevertheless spreads intelligence rapidly and unerringly in country districts, will, in each veterinarian's community ultimately convey the news that immunizing pays, or that it does not pay; and the veterinarian must have it whispered abroad that immunizing their herds pays his clients or he will "kill the goose that lays the golden egg."

CHAPTER X

HOG CHOLERA, MEAT INSPECTION AND GARBAGE FEEDING

Hog cholera is a widespread disease affecting just one species of animal used solely to produce meat for human food, and its status as far as meat inspection is concerned is necessarily well established. The following paragraphs from Edelman¹ set forth the broader principles which govern the formulation of more detailed and specific regulations which are in force in various abattoirs throughout the country:

“Judgment of the meat in swine erysipelas swine plague and hog cholera. In view of the fact that meat of these diseased animals has frequently been eaten for food without ever having incurred any impairment or injury to man, it can hardly be classed as injurious to health. In individual cases however the following should be considered:

“1. The entire carcass is unfit for food as soon as marked substantial changes (congestion of blood, serous infiltration, degeneration, yellow discoloration) of the musculature or fatty tissue are observed or when marked emaciation has occurred.

¹Edelman, *Meat Hygiene* (English translation by Mohler and Eichhorn; 2d edition, 1911).

“2. In all other cases, with the exception of the chronic forms of swine plague and the sequelæ of this disease and those of hog cholera, the carcass in all of these diseases is to be considered fit for food but subject to certain conditions. For veterinary sanitary reasons, and partly in consideration of the causative agents in the blood of swine erysipelas, swine plague and the acute forms of hog cholera, the meat and fat are to be boiled, steamed (rendered into lard) or pickled. The portions affected by the disease should be condemned.

“3. In case of slow chronic forms of swine plague without disturbance of the general condition, or sequelæ of this disease (adhesions, cicatrices, capsulated caseated areas etc.) or of hog cholera (caseation of mesenteric lymph glands, adhesions of intestines, formation of cicatrices in the intestinal mucosa) only the affected portions of the meat are to be condemned and destroyed. The remainder of the carcass is fit for feed without any restriction.”

It will be observed that swine plague and swine erysipelas are governed by the same general considerations that apply to hog cholera. In view of the fact that swine plague occurs most frequently as a complication of hog cholera as well as of the fact that rapid differentiation of all three diseases based on abattoir examinations alone is not possible, it is fortunate indeed that these diseases run so nearly parallel in their relation to meat inspection.

From the excerpt from Edelmann we glean the following essential considerations: first, the fitness of the meat for human food is based on patho-

logical changes in the meat itself, and is not determined by the probable presence or absence of the causative agents of hog cholera, swine plague or swine erysipelas; second, carcasses of hogs which before slaughter were obviously suffering with any one of the three diseases, may, in the absence of extensive pathological changes in the meat itself be passed for human food, but for veterinary sanitary reasons it should be boiled, rendered or pickled in order to destroy causative agents of either of the three animal diseases which it may contain.

A review of these facts leads logically to the conclusion that as far as hog cholera is concerned there is, and can be, no sharp line of demarcation between carcasses that are fit for human food and those which are unfit, because it has not been shown that hog cholera virus is injurious to man. The more important phase of meat inspection as it applies to hog cholera centers around the decision which determines whether a particular carcass requires special treatment (boiling, rendering or pickling), in order that parts of it may not subsequently infect other swine. Edelmann states clearly the need for a distinction between the fit and the unfit based solely on veterinary sanitary reasons, but he is silent as to how this distinction is to be made.

The U. S. Bureau of Animal Industry meat in-

spection regulations are much more specific in regard to the manner in which the distinction between the fit and the unfit shall be drawn, but the distinction is based wholly on considerations dealing with the fitness of the meat for human food. Veterinary sanitary considerations, which would include attempts to require cooking or rendering of all carcasses which contain hog cholera virus, do not enter in. The parts of these regulations which refer specifically to hog cholera read as follows:

“Regulation 9, section 2, paragraph 2. All hogs plainly showing on ante-mortem inspection that they are affected with either hog cholera or swine plague shall be marked ‘U. S. condemned’ and disposed of in accordance with section 8 of this regulation.

“Regulation 9, section 2, paragraph 3. If a hog has a temperature of 106° F. or higher, and if it is of a lot in which there are symptoms of either hog cholera or swine plague, in case of doubt as to the cause of the high temperature, after being marked for identification, it may be held for a reasonable time, under supervision of an inspector, for further observation and taking of temperature. Any hog so held shall be reinspected on the day it is slaughtered. If upon such reinspection, or, when not held for further observation and taking of temperature, then on the original inspection, the hog has a temperature of 106° F. or higher, it shall be condemned and disposed of in accordance with section 8 of this regulation.

“Regulation 9, section 2, paragraph 6. All animals which, on ante-mortem inspection, do not plainly show, but are suspected of being affected with, any disease or

condition that, under these regulations, may cause condemnation, in whole or in part, on post-mortem inspection, shall be so marked as to retain their identity as suspects until final post-mortem inspection, when the carcasses shall be marked and disposed of as provided elsewhere in these regulations, or until disposed of in accordance with section 7 of this regulation.

“Regulation 9, section 4, paragraph 1. All hogs, even though not themselves marked as suspects, which are of lots one or more of which have been condemned or marked as suspects under section 2 of this regulation for either hog cholera or swine plague, shall so far as possible be slaughtered separately and apart from all other animals passed on ante-mortem inspection.

“Regulation 9, section 7, paragraph 3. A hog suspected of being affected with hog cholera or swine plague may be set apart and held, under bureau supervision, for treatment with anti-hog-cholera serum. If at the expiration of the treatment period the animal upon examination is found to be free from disease it may be released for any purpose.

“Regulation 9, section 8. Except as hereinafter provided in this section, animals marked ‘U. S. condemned’ shall be killed by the establishment, if not already dead, and shall not be taken into an establishment to be slaughtered or dressed; nor shall they be conveyed into any department of the establishment used for edible products; but they shall be disposed of and tanked in the manner provided for condemned carcasses in regulation 14. The ‘U. S. condemned’ tag shall not be removed from, but shall remain on, the animal when it goes into the tank. The number of such tag shall be reported to the inspector in charge by the bureau employee who affixed it, and also by the bureau employee who supervises the tanking of the animal, provided, that any animal condemned on account of hog cholera and swine plague, as prescribed in paragraph 1, 2,

or 3 of section 2 of this regulation, may be set apart and held, under bureau supervision, for treatment with anti-hog-cholera serum, the requirement that such animal shall be killed shall be held in abeyance to await the result of the treatment. If at the expiration of the treatment period the animal upon examination is found to be free from disease, the 'U. S. Condemned' tag shall be removed and the animal released for any purpose."

Post-mortem inspection.

"Regulation 11, section 4, paragraph 1. The carcasses of all hogs marked as suspects on ante-mortem inspection shall be given careful post-mortem inspection; and if it appears that they are affected with either acute hog cholera or swine plague they shall be disposed of in accordance with paragraph 2 of this section.

"Regulation 11, section 4, paragraph 2. Carcasses of hogs that show acute and characteristic lesions of either hog cholera or swine plague in any organ or tissue, other than the kidneys or lymph glands, shall be condemned. Inasmuch as lesions resembling those of hog cholera or swine plague occur in the kidneys and lymph glands of hogs not affected with hog cholera or swine plague, carcasses of hogs in the kidneys or lymph glands of which appear any lesions resembling lesions of hog cholera or swine plague—shall be carefully further inspected for corroborative lesions. On such further inspection—

"(a) If the carcass shows such lesions in the kidneys, or in the lymph glands or both, accompanied by characteristic lesions in some other organ or tissue, then all lesions shall be regarded as those of hog cholera or swine plague, and the carcass shall be condemned.

"(b) If the carcass shows in any organ or tissue, other than the kidneys or lymph glands, lesions of either

hog cholera or swine plague which are slight or limited in extent, it shall be passed for sterilization in accordance with regulation 15.

“(c) If the carcass shows no identification of either hog cholera or swine plague in any organ or tissue other than the kidney or lymph glands it shall be passed for food unless some other provision of these regulations requires a different disposal.”

For years it has been a common practice among swine raisers to consign hogs to market as soon as hog cholera appeared among them, and even at the present day, when an effective preventive of the disease is at hand, the custom still prevails. If an entire herd consists of hogs nearing completion of the fattening period, and if cholera is recognized as soon as it appears, the loss to the feeder is not heavy. He promptly markets all hogs that are apparently well, leaving behind the few that are visibly sick. If, though, a herd includes sows, pigs and shoats which cannot be marketed to advantage, or if it consists of pure-bred animals, heavy and unnecessary loss must be accepted in consigning it to market. Unfortunately the loss is not confined to the man who ships the infected hogs. His herd becomes a menace to others in the vicinity as it is driven to the nearest loading station, and it helps to perpetuate the infection which, existing in practically all large public stockyards in the country, threatens all cholera susceptible swine not intended for immediate

slaughter. Nor is the danger terminated when the hogs reach the shambles. An impression prevails that in establishments where meat inspection regulations are in force, carcasses that contain hog cholera virus are condemned, and those that do not contain it are passed for food. This is not the case. Many carcasses that contain the virus readily pass inspection, and although they are perfectly fit for human food, trimmings from them regularly find their way into garbage, and when this is fed to susceptible hogs, they, in turn, contract disease. It is a vicious cycle, and one very difficult to break.

When a consignment of hogs from a cholera infected herd reaches an establishment where federal meat inspection regulations are in force it is first subjected to ante-mortem inspection. With respect to hog cholera it may contain five classes of hogs: first, dead hogs; these are condemned and tanked: second, hogs that show undoubted symptoms of cholera; these also are condemned and tanked: third, those that show suspicious symptoms and temperatures below 106° F., these are slaughtered; carcasses that show hog cholera lesions are condemned or passed for sterilization according to the extent of the lesions; those that show no lesions are passed for food: fourth, hogs apparently normal, and those which show suspicious symptoms, having temperatures above 106°

F.; these are condemned or isolated for further temperature records; in case further temperatures are taken the animals are condemned if the readings are still above 106° ; otherwise they fall into class three or class five: fifth, apparently normal hogs that show temperatures below 106° ; these pass ante-mortem inspection and post-mortem as well if they do not show lesions of hog cholera in organs *other than the kidneys or lymph glands*.

Let us consider the individual hog. Briefly stated, the requirements in order that it may pass inspection are that it shall not show conclusive symptoms of hog cholera, it shall not show suspicious symptoms plus hog cholera lesions, it shall not maintain repeated temperature readings above 106° F., and regardless of ante-mortem findings the carcass shall not on post-mortem show hog cholera lesions in organs other than the kidneys or lymph glands. What are the chances for carcasses that contain hog cholera virus to pass inspection?

This question is best answered by considering the average case of hog cholera. Let us suppose that a hog becomes infected to-day. According to Dorset, "Repeated experiments have shown that the blood of pigs that have previously been inoculated with the virus of cholera becomes infectious for others within twenty-four hours; the

urine and feces contain the virus usually in forty-eight hours, and the secretions of the eyes and nose become infectious by the third day following infection: therefore these experiments show that infected pigs are capable of transmitting the disease before they themselves show any visible illness.”¹

Thus the blood and therefore the meat of a hog infected to-day will to-morrow contain hog cholera virus sufficient to infect others, but there will be neither symptoms, temperature readings nor lesions to cause its condemnation. The same will be true on the second, third and fourth days following infection, but from that time on we may at any time expect developments that would cause condemnation. These may, though, be delayed several days longer. *There is a time, at least three days on an average, in the lives of practically all hogs affected with acute hog cholera when they will pass inspection and when bits of pork from their carcasses will infect other swine to which they are fed.* This interval varies from one or two to several days, and is measured, roughly, by the time required, after the first twenty-four hours following infection, for the temperature to rise to 106° F., or for conclusive symptoms or extensive cholera lesions to appear.

¹ Report of the chief of the U. S. Bureau of Animal Industry for the year ending June 30, 1917.

With these facts in mind, let us again consider the farm herd from which cholera infected hogs are shipped. Often a considerable number must die before the owner will admit, even to himself, that he is dealing with hog cholera. Then there is the delay incident to securing transportation, and there are many hours during which infected and sound animals are crowded together in a stock car. Finally, after the hogs reach the yards there is an additional delay of several hours or even several days before they are killed. Any person familiar with hog cholera knows that in such a consignment a great majority of the hogs become infected before they are killed and any person familiar with present-day meat inspection regulations knows that under such circumstances the vast majority of the infected animals will pass inspection. The hogs have every chance to become infected but the disease does not have time to develop sufficiently to cause their condemnation.

The practice of marketing swine herds as soon as cholera appears is no longer necessary. It rarely profits the man who follows it, and it perpetuates hog cholera, working great harm to the swine industry. Before the discovery of protective serum a herd of hogs once infected with cholera became a total loss unless some of the animals could be salvaged by slaughter. With the plentiful supply of serum now available an infected herd

can safely and profitably be kept at home. All that is required is prompt reporting, prompt diagnosis and prompt serum treatment. With few exceptions serum will, at any given time, save all hogs which are not at that time already dangerous carriers of hog cholera virus.

In the United States, during the decade ending in 1911 approximately 18,000 hogs were condemned annually on account of hog cholera. In 1914 the number reached a total of 116,000; in 1917, 33,000. According to Bureau of Animal Industry estimates, 40 per cent of the pork which is killed and 15 per cent of that which is marketed in the United States is slaughtered on farms or in abattoirs in which no inspection is maintained. Judging from my study of the situation as a whole, my belief—which I would be reluctant to express in concrete terms if it were not essential to convey at least an approximate idea of existing conditions—is that in the country at large, for each hog which is condemned for cholera, at least three virus-containing carcasses pass or evade inspection. What becomes of them subsequently?

Each infected carcass possesses almost infinite possibilities in regard to its final distribution. Whether the pork reaches the consumer in the form of hams, shoulders, or bacon, or whether it is fresh, refrigerated or cured, we should not lose sight of the fact that it actually contains unlabeled

hog cholera virus, and that uncooked portions of it fed to susceptible hogs will produce cholera.

Of the various preserving and preparing processes to which pork is subjected before being sent to the consumer, only one that we know of—cooking—is certain to destroy hog cholera virus which it may contain. According to extensive experiments ¹ which we have carried out the virus lives in fresh meat until decomposition sets in, it is not affected by prolonged refrigeration, and a representative sugar curing and smoking process killed it in only 43 per cent of the tests made.

So far we have dealt chiefly with the facts surrounding hog cholera and meat inspection as they have been determined by exact scientific methods and recorded data. It remains to be added that clinical observations are entirely in accord with these facts. We hear of one outbreak of hog cholera in Canada, and it is traced to a consignment of infected hams; we hear of another in a remote lumber camp in the Adirondacks where hogs are kept to consume the kitchen refuse; and of still another on an inaccessible farm in Nevada following purchases of market pork. These are merely representative instances. At least 90 per cent of the outbreaks we encounter in New York can be traced to no other source than infected pork trim-

¹ Report of New York State Veterinary College 1915-1916, page 60.

mings in garbage, and in other Eastern states the situation is essentially the same. Torrance¹ reports similar conditions in Canada. In the Southern and central states a much smaller proportion of herds become infected through the agency of pork trimmings from carcasses that contain hog cholera virus, but even in these sections there is ample evidence that the first infection in many outbreaks takes origin in this manner. Once established in territory that supports a dense swine population, the disease spreads rapidly through many other agencies.

Meat inspections in field outbreaks of hog cholera. The practicing veterinarian who is called to handle a farm herd infected with hog cholera very frequently is questioned regarding killing and marketing all animals that remain apparently well. How is he to advise his clients?

Disregarding, for the moment, legal and sanitary considerations, and thinking only of the plan that will cause our clients the least immediate financial loss, we will find relatively few instances where immediate slaughter can be advised. These occur principally in herds of feeders about ready for market anyhow, and in herds in which the disease has progressed so far that protective serum offers very little hope. In either case the

¹“Garbage Feeding in Relation to the Control of Hog Cholera,” *Journal of the American Veterinary Medical Association*, October, 1921, p. 22.

hogs are worth more as pork than they will ever again be worth on foot, but here legal and sanitary considerations enter in, and it is only where the state law provides for slaughter under inspection and where provision can be made to minimize the danger to other herds that may result from marketing the pork, that slaughtering is to be advised.

New York, for instance, has a law which permits killing under inspection from herds infected with cholera, but it is only at institutions and on farms where the pork will not be placed on the open market that we have advised such a course. We habitually follow the plan of explaining the situation to our client, and informing him that he has a legal right to kill, but that he has at the same time a moral obligation to protect his neighbor. When we offer at the same time the alternative of serum treatment, giving a prognosis as nearly exact as is possible, there are few who will not decide to use serum or who will not profit by doing so. Indeed in just one instance that we recollect has one of our clients elected to take shelter under the law and disregard his neighbor. This man had a herd consisting originally of about four hundred hogs. Cholera appeared, but he refused to accept our diagnosis. Finally when his herd had dwindled to about one hundred and fifty animals, he decided to vaccinate. It was a forlorn hope, but we began

taking temperatures, intending to administer serum only to those that showed readings below 104° F. After numerous trials in which we found but a negligible number of readings below 106° F., we gave up the attempt and returned home. Later we were informed from reliable sources that immediately on our departure about seventy-five hogs from the herd were shipped to market and that the majority of them passed federal inspection.¹ The man in this instance received more for the hogs than he would have received had he administered serum to all of them as an eleventh-hour measure, but he received infinitely less than would have fallen to his lot had he treated the herd with protective serum at the time when he was first warned of the danger.

In those instances in which the practicing veterinarian is called to inspect hogs that are being slaughtered from cholera-infected herds, the federal meat inspection regulations² should be selected as a convenient guide, but unless it is so specified by state law, they are not to be regarded as inflexible or final. The practitioner must

¹ This must not be construed as a criticism of the *administration* of the federal meat inspection regulations. It is merely a rather striking example of the fact that the regulations, admirably formulated and enforced to protect human health and human life, cannot be relied on to eliminate from our markets swine carcasses that contain hog cholera virus.

² The paragraphs that relate to hog cholera appear near the beginning of this chapter.

adapt his decisions to the conditions under which he is working. If he knows that the pork is to be sold in the open market where it will become the potential cause of future outbreaks, he cannot be justly criticized if he is relatively severe in his decisions; on the other hand, if the pork is to be retained at the place where it is killed, as it is on some institution farms, for instance, rather extensive hog cholera lesions should be required in order to condemn. Carcasses that are not deemed fit for pork can be partially salvaged in the form of lard.

When slaughter on the farm is decided on, ante-mortem inspection should consist first of observing the hogs before they are disturbed, and rejecting any that obviously are suffering with hog cholera. Then temperatures may be taken of those that remain and any that show readings above 106° F. should be condemned or put aside for subsequent readings. Later if they show temperatures below 106° F. they may be slaughtered and post-mortem findings will determine whether the carcass shall be passed or condemned. In case the weather is very warm, or if it is necessary to excite the animals unduly in taking temperatures, one may secure more accurate information by giving them a limited quantity of feed and rejecting those that do not remain at the trough and eat greedily. Nearly all will come to the trough at

first, but those that are suffering most with cholera will soon return to the nest.

Principles governing post-mortem inspection have already been discussed. Briefly, extensive changes in the meat or fat should cause condemnation. Hog cholera lesions in the kidneys and lymph glands do not condemn the carcass, although in cholera-infected herds such lesions practically always establish its status as a virus carrier. Carcasses that show hog cholera lesions in the kidneys, lymph glands and other organs as well are not used for pork, but if the lesions are slight in extent the fat may be rendered into lard. Most hogs that appear well on foot pass post-mortem inspection as well.

Garbage Feeding

Intimately bound up with meat inspection as it applies to hog cholera is the subject of garbage feeding. As we have already shown this practice is the final link in the chain which is responsible for the introduction of cholera into so many herds of hogs. If meat inspection regulations become more stringent, garbage feeding becomes less hazardous; if they become less stringent, or if they are neglected altogether the risks from infected pork trimmings in garbage increase. In any event, chance alone decides when any partic-

ular herd that subsists on garbage will contract hog cholera. The larger the herd, the greater the supply of garbage necessary to maintain it, and the more certain it is to become infected.

In earlier years feeding garbage to hogs has produced the most surprising and contrasting results. Its feeding value has long been well known, and men who were tempted to utilize it in feeding hogs usually began the practice on a small scale. If hog cholera did not happen to reach the herd during the first year, the financial returns were usually gratifying beyond expectations, and the hog raiser enthusiastically increased the size of his herd—at the same time multiplying its chances to become infected with cholera. Thus a common experience was for the breeder to have the savings of one or more years invested entirely in hogs when cholera finally reached his herd and destroyed it.

Various preventives of the disease incident to garbage feeding were advertised, and magic formulas were passed around by word of mouth. Perhaps one man fed salt and sulphur to his hogs and did not lose a single one; another neglected to do this and his entire herd was destroyed. Could any proof be more convincing? But the law of chance was still in operation, and hog cholera was relentlessly striking down one herd after another, including those which received the lauded

preventives with those that did not, in a wholly impartial manner.

There was a belief that garbage in itself produced the disease, and there was divided opinion as to whether it was dietetic in nature or whether it was really hog cholera. The trouble was thought by some to be due to a variety of causes—as in truth it was to a limited extent—but when anti-hog-cholera serum was brought into use it was found that this product prevented most rapidly-fatal infectious disease which had formerly plagued the garbage feeder's herd. Also the advent of kitchen sinks and drains eliminated soap poisoning due to dish water which was formerly included in garbage. These two advances have placed garbage feeding on a relatively safe basis.

The collection and disposal of city garbage is a complex and exacting process, and staggering sums are paid annually for this service. Disposal plants cost huge sums of money as original investments, and coal, labor and upkeep incident to their operation require a heavy and continuous outlay. One city of 100,000 that we know of—and it is no exception—was until recently incurring the expense of collecting its garbage and hauling it three miles to a disposal plant, and it was also operating the plant at an annual expense of \$40,000. The garbage was burned and there was no salvage, as

there is in some disposal plants, in the form of grease, tankage and bones.

Viewing the subject of garbage feeding from the standpoint of the municipality it may be said that in cities of less than 100,000 feeding is by far the most economical plan of disposal, and experience will probably prove that the same rule holds good for larger cities. If provisions are made for feeding, no city of less than 100,000 should find it necessary to pay disposal costs, and many should be able to offset in some degree, collection costs as well. Cities that elect to dispose of their garbage by feeding may maintain piggeries as a municipal function, or they may provide by contract for collection and disposal. We believe the most satisfactory plan is for the city to collect the garbage and deliver it to the contractor's piggery or to a specified loading station.

Long term contracts with optional renewals on the part of the contractor are the only ones that will prove satisfactory when the plan is to feed the garbage. No man can afford to build adequate quarters for large numbers of hogs unless there is assurance of a constant supply of feed during a term of years. Short term contracts are responsible in large measure for the fact that the garbage feeder's establishment is so often a public nuisance. He does not have time to organize his

feeding operations, he cannot invest in good equipment that will have to be sold at a loss as soon as his contract terminates, and there is not sufficient time for the enterprise itself to yield profits that may be returned to it in the form of equipment.

When a city wishes to let its garbage contract to the best advantage it should agree to give the contractor all the municipal garbage, and it should provide ordinances that require its drainage and the exclusion of tin cans, broken bottles and the like. Collections should be required at least once a week in winter and twice in summer. A five-year contract which the contractor can renew at his option if he discharges his obligations, is satisfactory, and will serve to entice reliable contractors.

Municipal piggeries are successful sometimes, but changing city administrations are not always to their best advantage. Sooner or later self-styled "business men" are likely to be charged with their general supervision, and in formulating business rules for their subordinates they themselves are likely to ignore essential natural laws governing swine husbandry and the handling of swine diseases. Business principles must of course be observed, but they must be made to dovetail with principles that conserve the health of the swine and provide each day for their intelligent care.

Garbage varies greatly in feeding value, but as a very general rule one ton of well drained city garbage which is free from extraneous matter will feed about fifty or sixty fattening hogs, causing them to gain from $\frac{3}{4}$ to one pound each. In other words one ton of garbage should produce about fifty pounds of pork. At least 200 pounds of a good grain ration is required to produce the same gains. Thus as far as the public at large is concerned dumped or burned garbage represents a great and avoidable waste, and in states with large urban populations this waste assumes huge proportions.

Veterinary Supervision of Garbage-Fed Herds

Herds of hogs fed on city garbage are constantly threatened with cholera, and for this reason they sooner or later come under the veterinarian's care. The dangers nowadays are frequently known in advance and hence professional advice is sought before a herd is assembled, but many feeders are still ignorant of the chances they assume, and still others procrastinate in regard to immunizing.

When a veterinarian is consulted before a herd is assembled, or before hog cholera appears in it he can render service of a high order if he is familiar with disease prevention and swine husbandry methods. He also assumes considerable

responsibility, for, given a clean herd he is supposed to know how to keep it clean. The prevention or handling of hog cholera in herds fed on garbage is not different in principle from handling the disease in other herds, but there are several difficulties peculiar to the garbage-fed herd that must be overcome. These difficulties are so closely linked up with methods of swine husbandry that all must be considered at the same time.

Should the garbage feeder raise or purchase feeding hogs? Many considerations enter in, but as a general rule if the herd is to be relatively small, say less than 500, if there is provision for exercise and a little pasture, if warm farrowing pens can be provided, and if a supervisor who thoroughly understands swine breeding can be secured, the best plan is to raise the pigs. Under ordinary conditions, as the herd is increased in size, raising the pigs becomes relatively less feasible. The question of proximity to a good market for good feeding shoats likewise must be considered, and what we have said in a preceding chapter in regard to handling feeder hogs, applies here as well. Shoats that have been immunized on the farm are by far the safest purchase, and susceptible ones that can be purchased from thrifty farm herds may be immunized without much danger. Purchase of stockyard hogs is ad-

visible at times, but judicious selection and careful handling are essential, and even then the best professional care does not always insure against considerable loss from hog cholera and its complications.

When it is desirable to purchase feeding shoats to consume garbage, those weighing between 75 and 120 pounds are most desirable. Although it is feasible to raise the very best pigs on garbage alone, the fact remains that often they begin to eat it well and put on rapid gains only after they have attained considerable size. It is likewise true that shoats cannot be put on full feed as rapidly when garbage is fed as they can when their ration consists of grain, hence it is well to purchase rather light shoats so that the loss of time in getting them started can be made up by a relatively long fattening period.

Except when cholera immune shoats are purchased from the farm it is necessary that immunizing shall take place before or immediately after they reach the feeder's yards, and thus they must often undergo the resulting reaction before the condition known in the fattening pen as "full feed" is reached. Special care is necessary not to overfeed at this time. Efforts to crowd the animals beyond their capacity may aid in causing "serum breaks," and do injury that will require weeks to overcome. With this one special

precaution our readers are referred to the heading in the last chapter entitled "Handling Feeder Hogs."

It is in raising pigs entirely on garbage that the greatest care is required. Numerous pitfalls are in the path of the beginner, and it is a quite general rule that one serious disaster is necessary to impress him with the necessity for avoiding neglect. The critical period in a pig's life is from weaning time until he reaches a weight near 75 pounds. When garbage is to be the sole feed it is a great mistake, and a common one, for the pigs to be weaned while they are very young. The breeder is anxious that the sow shall produce another litter as soon as possible, and thus it is not uncommon for weaning to take place when the pigs are four weeks old, or a trifle more. They are then too young to gain well on garbage alone and they are subject to various dietary troubles that are not often observed in pigs weaned later in life. One good litter a year born quite early in the spring and nursed until the pigs are eight or even twelve weeks of age is more profitable than two litters weaned too young. However when warm farrowing pens are provided it is not necessary to choose between one litter a year, and two. The sow can nurse her litter the required time and then be bred at the first period of heat fol-

lowing weaning of the pigs regardless of the time of year that farrowing will occur.

When the pigs are weaned too young "runts" are common among them, and in waiting for the animals to become of sufficient size to receive simultaneous treatment it is not uncommon for the breeder to prolong to a dangerous degree the interval between serum alone and simultaneous treatments. The passive immunity due to the former partially disappears, and hog cholera, frequently of an atypical and subvirulent type, sometimes appears among them. Often this type of the disease is not recognized as hog cholera. Pigs in large herds require earlier serum alone treatment and are more likely to require two treatments prior to the final serum-virus administration than are those in smaller herds. This is because of the fact that in large herds the chances for infection are so great that the virus of the disease must be regarded as being continuously present.

Pasture and abundant room for exercise are of great benefit to young pigs that subsist on garbage. There seems to be a general fear that pigs will "run all the fat off them" if they are allowed generous room for exercise. We have repeatedly observed the effects of turning pigs from cramped and dirty quarters into pastures or large enclosures, and the change has always been in their

favor. Granting good weather conditions, very young pigs that become exhausted in attempts to follow the sow, and feeders near completion of the fattening period are the only exceptions to this rule.

There is a tradition that hogs grown on garbage from generation to generation become accustomed to it and consume it to better advantage. Formerly we were inclined to regard this belief as being without foundation on fact, but in later years we have seen evidence that causes us to change our views. It is certain that sows purchased from grain-fed herds and required to subsist on garbage frequently fail to farrow large litters in the spring subsequent to the change, and while this may often be explained on the ground of insufficient exercise and overfat condition, this explanation covers only a portion of the cases. If we were purchasing breeding animals for a garbage feeding establishment we would regard it of considerable advantage to secure them from herds long accustomed to that kind of feed.

Pigs must have dry sleeping quarters or they will not thrive. Due to the excessive moisture in garbage, wet quarters are a common and disastrous cause of unthriftiness among pigs that subsist on it. The greater the run allowed the pigs the easier it is to keep them dry. When the quarters are of necessity somewhat crowded, special

provisions are necessary or all parts of the floor will be damp. This difficulty can be obviated by constructing overlays consisting of floors of matched material built on two-by-fours laid flat. These are built up around the edges so that in effect they are wide shallow boxes which contain the litter. They should be located as far as possible from the platform where the garbage is fed.

What we have said in preceding chapters in regard to maintaining herds immune to hog cholera applies as well to those that subsist on garbage. Young garbage-fed pigs are relatively somewhat slow in getting started, hence they require a little extra care such as we have already outlined. In the absence of this care they are in more or less danger of falling victims to various influences that retard growth, or to ill effects following simultaneous treatment administered at a time when they are not in the best condition to withstand it.

Garbage Feeding and Sanitary Considerations

We have already described the cycle which enables the practice of garbage feeding to aid in perpetuating hog cholera. The ways in which this cycle can be assailed remain to be considered. Our attacks should include efforts to prevent shipment from cholera infected herds, gradual revision of our meat inspection regulations with a

view to reducing the number of virus containing carcasses that are placed on the market, measures to license and control establishments where garbage is fed, and educational activities designed to acquaint breeders with the risks they assume when they feed even a limited quantity of garbage.

Measures to prevent shipment from cholera-infected herds may take two forms: first, the alternative—prompt serum treatment—should be made available to every breeder, and practicing veterinarians will do well to school themselves in handling hog cholera on the farm, so that the folly of marketing infected hogs will be obvious to the breeder; second, some form of penalty should be attached to the practice. It is obviously impossible to reach all offenders but the more flagrant ones could easily be detected, and the effect would be wholesome. When a shipment of swine arrives at the yards containing a considerable number of dead hogs and many others obviously infected with cholera, the chances are that most of the animals in it will produce carcasses which contain the virus. If it could be made compulsory to market such carcasses only in the form of safe but less valuable cooked products, and if the hogs in such a shipment were so tagged and identified that the shipper himself had to accept the consequent loss, there would be fewer cholera infected

herds marketed, and a higher price for sound ones would prevail.

Ante-mortem inspection could at least be made to incriminate an entire shipment containing hogs obviously infected with cholera to the extent of requiring a more severe interpretation of lesions in individuals contained in it. While it is true that petechiæ in the kidneys and peripheral hemorrhages in the lymph glands, for instance, may be due to causes other than cholera, it is likewise true that in shipments such as we have described these lesions are, with negligible exceptions, conclusive evidence of the disease.

License and control of garbage feeding establishments have much to recommend them. Surrounding the average city, under present conditions, are numerous small herds in which garbage is being fed, and in each one lurks the danger of an outbreak of hog cholera. If a licensing system were in operation, instead of having many unknown sources of infection without any control whatever, we would have a limited number of known sources, in which methods could be so regulated as to minimize danger due to spread of the infection. It would be possible to require immunization of all hogs fed on garbage—an advantage rather than a burden to the individual feeder—and it would likewise be possible to govern the

location of garbage feeding establishments, and to require adequate equipment for their operation.

Regulations in Canada require that all men who plan to feed garbage shall first secure licenses, and the plan seems to be working well; principally, we believe, because the sources of danger are limited in number and known. Cooking the garbage is required, but this, in our experience, is a measure of doubtful value. There is no doubt that a boiling temperature will kill the virus, but there is doubt that such a temperature will actually be applied to all garbage fed in any establishment. We have frequently seen neglect of this kind end in disaster. In one instance we were called to handle an outbreak of hog cholera at a large sanitarium where provision had even been made for cooking all garbage under pressure. An unguarded interval during which the apparatus was temporarily out of order was responsible for this outbreak. Immunizing the herd is usually far safer than cooking the garbage on which it is fed, and it has the additional advantage of protecting against all sources of infection.

Despite the need for various measures to protect the swine breeder's herd, the fact remains that the measures which he himself can apply will be most effective. He can exclude all pork trimmings from the kitchen refuse which he feeds, he can discontinue feeding garbage, or he can in co-

operation with his veterinarian keep his herd immunized. Either measure faithfully carried out will protect his herd from cholera infection directly due to garbage feeding.

CHAPTER XI

CONTROL AND ERADICATION OF HOG CHOLERA

CONTROL of an infectious disease means that rather definite limits have been placed on its spread. Eradication, as applied to a particular area, implies that all the virus which causes the disease has been killed, and that the malady can no longer exist unless it is introduced from without. Naturally, in a country in which an acute and fatal infectious disease such as hog cholera is widely disseminated control is the first consideration. But eradication is the distant goal, and while our progress toward this goal must at times yield to expediency, there must be no permanent or long surrender to methods that contribute nothing toward the ultimate purpose.

Long acceptance of losses due to hog cholera has given us a fatalistic attitude toward the disease. Like the poor, it is always with us and we habitually expect and tolerate it as we expect and tolerate inclemencies of weather or the infirmities of old age. If a foreign infectious swine disease, equally destructive and equally well understood, were to appear in this country, even though

it were to gain a firm foothold, those whose interests were threatened would demand its eradication and the veterinary profession in coöperation with many breeders—and in spite of the violent opposition of a few—would eradicate it.

The first prerequisite, then, is a change on the part of veterinarians, breeders and the public from a passive to an active attitude toward hog cholera. In expressing this view we must not be understood as declaring our faith in a short and intensified campaign against the disease, for the methods that finally succeed will involve details which must grow out of a continual process of trial and adjustment; but the start must be made, the goal must be kept clearly in view, and constant, active and unyielding pressure must be brought to bear on the most obvious practices that serve to perpetuate the disease.

During the last four decades hog cholera has caused in this country annual losses ranging between \$13,000,000 and \$200,000,000, killing annually an average of 66 out of every 1,000 hogs. About once in each decade the disease becomes greatly intensified and in 1887, 1897 and 1914, respectively, the number of hogs killed by it rose above 10 per cent of the country's entire swine population. These are staggering losses, and when one reflects that they will continue indefinitely unless intelligent, organized efforts are

made to check them the advantages of such efforts become self-evident.

It is not impossible to eradicate hog cholera. The task presents no such difficulties as are encountered in the eradication of bovine tuberculosis, for instance. Hog cholera does not exist long unknown to the owner of the herd it infects; individuals apparently well do not regularly live year after year disseminating the virus; deaths due to it are rapid and certain and the resulting losses are obvious; it is a foe that strikes in the open. The disease can be stamped out quickly in any herd, and there is an immunizing agent so effective that prompt reporting is the breeder's surest way to avoid loss. When we reflect on the significance of these facts we may well be led to wonder why the disease does not disappear. The truth is that it does tend to do so, for undoubtedly there are to-day many counties free from the disease that have suffered severely from it in past years, and that will suffer again when the virus once more is introduced from without.

When once the virus finds its way into a locality the methods by which it may spread from herd to herd are innumerable but it is time that we direct our attention to the sources of the original infections. We dissipate our energies in trying to control outbreaks of huge proportions instead of concentrating them on the prevention of primary

infections. The three most important methods by which hog cholera travels from locality to locality are:

1. **Marketing from infected herds.** The hogs thus shipped are a menace to others as they are taken to market, they keep stock cars and stockyards constantly infected, they are sometimes sold from the yards as feeders, and their carcasses are regularly placed on the market in large numbers where they serve to infect many new localities through the medium of garbage feeding.

2. **The transportation from public stockyards of susceptible feeder hogs, and those which receive simultaneous treatment immediately prior to shipping.** When susceptible feeders are placed in public stockyards they often become infected, and though they leave the yards apparently in good health they soon develop cholera and the farms which receive them become new centers of infection. Feeder hogs that receive simultaneous treatment and which are at once shipped to distant points, frequently "break" as a result, and thus introduce hog cholera into new territory.

3. **Wide and indiscriminate use of hog cholera virus in immunizing, especially by untrained men.** "Vaccination cholera" is still too common in farm herds, despite the fact that experienced men know how to avoid most of it.

These three practices have essentially the same relation to hog cholera eradication that the feeding of uncooked creamery products has to the eradication of bovine tuberculosis. They furnish obvious and wide-open routes for dissemination of the virus. Are they really necessary evils? Are there no possible ways to avoid them? Let us examine the three practices more in detail.

Marketing from infected herds. We have already shown that marketing from infected herds is a common practice, that it serves to spread hog cholera virus as the animals are driven to market and when trimmings from their carcasses later find their way into garbage that is fed to susceptible hogs. We have also drawn attention to the fact that feeders selected from these herds and shipped to distant points cause many new outbreaks of hog cholera. For our present purpose it remains to review briefly means by which this endless chain of infection can be severed.

The first object should be to keep cholera infected herds at home. Good local veterinary service will do much in this direction for it is the ill-advised breeder who ships his infected hogs to market. On the part of the meat inspection service, rigid interpretations of lesions in all individuals that come from lots obviously infected with hog cholera at the time they reach the yards

will serve to discourage shipping from infected herds, provided a tagging system is adopted which will place the losses due to condemnations where they belong—on the man who ships the hogs.

The second object should be to prevent the sale of carcasses of infected hogs that reach market despite efforts to keep them away. In other words, carcasses that obviously are carriers of hog cholera virus should not be sold except in the form of cooked products, for hog cholera will be with us as long as the practice continues. We have already mentioned the present deficiency of the federal meat inspection regulations as they apply to this particular point. Whether this deficiency is due to lack of authority or to failure to use authority already granted, the effect is the same—many carcasses that show lesions usually considered characteristic of hog cholera are still allowed to pass inspection.

It is deceptive to assert, as the regulations do, that these lesions are sometimes due to causes other than hog cholera. Granting, as we freely do, that this is true we still maintain that it is exceptional to such an extent that it should receive scant consideration in the judgment of carcasses that come from lots which contain hogs suffering with cholera when they reach the yards. Hogs that come from infected herds and that show

even slight lesions suggestive of cholera will yield carcasses that contain virus, almost without exception.

The third object sought should be that of neutralizing the effects of virus-carrying carcasses that pass inspection. To this end it should be made known among swine raisers that danger always lurks in the practice of feeding even small quantities of garbage that contain pork trimmings. A system of licensing garbage-feeding such as the one that now exists in Canada, is also worthy of consideration.

Transportation and sale of susceptible feeder hogs and those which receive simultaneous treatment just before shipping. Most public stockyards are contaminated with hog cholera virus, and eventually it should be so ordered that when susceptible hogs enter, it shall be for immediate slaughter only, and the gates shall close behind them forever. Previously we have drawn attention to the fact that "serum breaks" are frequently a result of giving hogs simultaneous treatment and shipping them immediately afterward.

Though this practice is probably the lesser evil as compared to shipping susceptible hogs from the yards without immunization, the fact remains that it is still a potent factor in the dissemination of hog cholera virus. Follow-up treatment as a substitute for simultaneous treatment given immedi-

ately before shipping, will do much to minimize this danger, but the ideal will be reached only when feeder hogs are permanently immune to hog cholera before they are shipped long distances.

It will take time to provide for an adequate supply of immune feeders so that shipping susceptible and recently-immunized hogs from public stockyards will not be necessary, but there are hopeful indications that this will be brought about. Men experienced in the feed-yard even now are eagerly seeking means of avoiding the heavy financial losses associated with "vaccination cholera" immediately following simultaneous treatment and shipping. Among such men there is an active demand for immune feeder shoats, and efforts are being made, though as yet on a limited scale, to supply this demand. The practice of assembling and immunizing feeders, and shipping them only after the resulting reaction is over is already being adopted by some serum companies. This is a step in the right direction, and our belief is that a promising field is open to others who will make a business of supplying the trade with carefully selected cholera-immune feeder shoats. When the supply of these animals is equal to the demand the practice of shipping susceptible and recently-immunized feeders from public stockyards will cease.

Indiscriminate use of hog cholera virus in im-

munizing. When the effectiveness of serum-virus immunization was first demonstrated the demand for these products far exceeded the supply, and hasty preparations were made to produce them in enormous quantities. Enthusiasm for immunization ran high, and it was looked on as the final solution of the hog cholera problem. Men without previous experience with disease and with no fundamental knowledge of the processes that produce immunity were drafted into service to produce and use products potentially capable of doing great harm. It was the accepted belief that all hogs should be immunized, that the process of immunization was a simple one requiring only a low grade of mechanical skill, that serum and virus could be administered without a suggestion of danger, and that the hogs receiving them were from the moment the doses were administered permanently immune to hog cholera. It is little wonder that impotent serum was sent out, that potent serum often fell into unskilled hands, and that some of the laboratories that featured "virus q. s. with all serum orders" sometimes sent out quantities that were just a little more than sufficient.

The Bureau of Animal Industry laboratory inspection service with the aid of many far-sighted serum companies has done much to correct these initial evils. The sale of impotent serum for use

with virus was much more readily prevented than were the disasters growing out of the use of good serum by untrained or indifferent men, and to-day it is to the latter abuse that most outbreaks of hog cholera which originate from laboratory virus must be attributed.

The task of reducing "vaccination cholera" to a minimum must be referred to a trained and awakened veterinary profession. There is an insistent demand that vaccination of hogs shall be placed in the hands of laymen, a policy which, if adopted generally, will be disastrous to the swine industry. Yet this demand will be heard—and heeded—as long as there is territory in which there are not qualified veterinarians to do the work.

Reducing the problem of hog cholera control to its simplest terms it may be said that in the individual animal the disease soon terminates, for the virus will destroy or immunize its host in a few weeks. Likewise in the herd the same principle applies, but if we expand our unit to include county, state or nation the difficulties that present themselves multiply accordingly. The limiting factors in the control of the disease are lack of thoroughly trained men, lack of understanding on the part of the public, and the expense involved.

The federal Bureau of Animal Industry has

demonstrated that the disease can be kept down in individual counties, but the expense involved was so great as to forbid use of the plan on a large scale. Area work in the eradication of hog cholera is, we believe, wrong in its conception as long as the virus continually invades the selected territory from without through the three channels that have just been indicated.

No successful standardized plan for the control of hog cholera has yet appeared. Killing infected and exposed animals and indemnifying the owners has been tried in England and Canada but results have not been such as to recommend wide application of the plan. Immunizing all hogs against cholera was once enthusiastically recommended, but we doubt if there can be found to-day an experienced man who considers this method feasible. It would involve the principle of forcing owners to vaccinate, the expense would be prohibitive, and the trained men necessary to carry it out do not exist.

In our appraisal of the coöperative forces which can be brought to bear immediately in hog cholera eradication we must include the swine breeder, the practicing veterinarian, the official veterinarian and the serum producer.

The breeder should be acquainted with the methods by which hog cholera is spread so as to be able to protect his herd against extraneous

infection. He should, with the advice of his veterinarian determine whether his herd is to be maintained immune to hog cholera, or whether it is to remain susceptible and be kept under observation. In case the former plan is adopted the practice of immunizing should not be allowed to lag, and in case the latter seems advisable he should report promptly any infectious disease that appears.

The practicing veterinarian's part consists in snuffing out the outbreaks as fast as they appear, in aiding owners to clean up their herds so that they will not serve to infect others in the vicinity, in doing the vaccinating incident to maintaining immune herds, and in advising his clients relative to methods by which their herds can best be protected. Only when the need for police power appears does the province of the practitioner terminate and that of the official veterinarian begin.

The official veterinarian's primary duty is to bring pressure to bear on the three principal practices that serve to spread hog cholera from locality to locality. By placing restrictions on the sale of hogs from infected herds and from public stockyards; by a far more severe interpretation of hog-cholera-like lesions in the administration of meat inspection regulations; by restricting the use of virus so that only trained men may handle it; and by continued supervision of commercial

serum laboratories the official veterinarian can play an indispensable part in the fight against hog cholera.

The serum producer's part is to supply sufficient potent serum to immunize all hogs that actually require immunization. Despite notable exceptions it must be said that on the whole the part has been played well, and when breeders, practicing veterinarians and official veterinarians, as classes, meet their obligations as well as the serum producer is meeting his, there will be far less hog cholera in the country.

Volumes could be written on the eradication of hog cholera if we were to follow the various ramifications into which details of the problem lead us. There are the questions of uniform regulations for interstate shipment of swine; of separate regulations for crated swine; of rules governing the exhibition of hogs at fairs; and of funds to administer laws and regulations that are already provided. These and many other supplementary problems appear but consideration of them here would only cloud the more important issues.

The points we emphasize in closing are that at the present time the obstacles presented in the eradication of hog cholera rest not so much in lack of machinery to do the work as in the manner in which the existing machinery functions; that three well-known wide-open routes for the inter-

sectional spread of hog cholera virus still exist and that they must be closed as the first step toward substantial progress in eradicating the disease. Only when this is accomplished can we correctly appraise the lesser task that will yet remain. At present the country's attitude toward hog cholera eradication may be likened to that of a farmer who each year sows weed seeds with his grain, and then labors diligently to eradicate the weeds that spring up. Let us stop sowing the seed.

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APPENDIX

B. A. I. Order 265.

Issued September 12, 1919.

UNITED STATES DEPARTMENT OF AGRICULTURE

Bureau of Animal Industry

JOHN R. MOHLER, *Chief of Bureau*

Regulations Governing the Preparation, Sale, Barter,
Exchange, Shipment, and Importation of Viruses,
Serums, Toxins, and Analogous Products Intended for
Use in the Treatment of Domestic Animals.

Effective on and after September 1, 1919

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U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., August 1, 1919.

Under authority of the act of Congress approved March 4, 1913, entitled "An act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1914" (37 Stat., 832), the following regulations are hereby issued for the purpose of enforcing the provisions of said act governing the preparation, sale, barter, exchange, shipment, and importation of viruses, serums, toxins, and analogous products intended for use in the treatment of domestic animals. These regulations, which for the purpose of identification are designated as B. A. I. Order 265, shall become and be effective on and after September 1, 1919, except that stocks of approved labels on hand may be used until December 31, 1920.

D. F. HOUSTON,
Secretary of Agriculture.

REGULATION 1.—DEFINITIONS

SECTION 1. *Paragraph 1.* For the purpose of these regulations the following words, phrases, names, and terms shall be construed respectively to mean:

Paragraph 2. The virus-serum-toxin act of 1913: "An act making appropriations for the Department of Agri-

culture for the fiscal year ending June 30, 1914," approved March 4, 1913 (37 Stat., 832).

Paragraph 3. Viruses, serums, toxins, and analogous products or veterinary biologics: All viruses, serums, toxins, and analogous products, such as antitoxins, vaccines, tuberculins, malleins, microorganisms, killed microorganisms, and products of microorganisms which are intended for use in the treatment of domestic animals.

Paragraph 4. The department: The United States Department of Agriculture.

Paragraph 5. The bureau: The Bureau of Animal Industry of the United States Department of Agriculture.

Paragraph 6. Bureau employee: Any officer, agent, or other individual employed in the Bureau of Animal Industry, who is authorized by the chief of the bureau to do any work or perform any duty in connection with the execution of the provisions of the virus-serum-toxin act of 1913.

Paragraph 7. Veterinary inspector: A veterinary inspector of the Bureau of Animal Industry.

Paragraph 8. Licensed establishment: Any establishment owned or operated by a person, firm, or corporation holding an unexpired, unsuspended, and unrevoked license issued by the Secretary of Agriculture for the preparation of any virus, serum, toxin, or analogous product.

Paragraph 9. Official station: One or more licensed establishments included under a single supervision.

Paragraph 10. Inspector in charge: An inspector assigned to supervise and perform official work at an official station and who reports directly to the chief of the bureau.

Paragraph 11. Person: Natural persons, individuals, firms, partnerships, corporations, companies, societies, and associations and every agent, officer, or employee

thereof. This term shall import both the plural and the singular, as the case may be.

Paragraph 12. Hog-cholera virus: The clear serum, plasma, or defibrinated blood, derived from hogs sick of hog cholera and free from other communicable disease or diseases.

Paragraph 13. Hyperimmunizing virus: Hog-cholera virus prepared for hyperimmunizing hogs which are immune to the disease hog cholera.

Paragraph 14. Simultaneous virus: Hog-cholera virus prepared for inoculating hogs which are to be injected simultaneously with anti-hog-cholera serum for the immunization of those animals against the disease hog cholera.

Paragraph 15. Anti-hog-cholera serum: The clear serum, plasma, or defibrinated blood, or derivatives thereof, containing the protective principles derived from immune hogs which have been hyper-immunized by an intravenous injection of at least 5 cubic centimeters, per pound body weight, of the virus of hog cholera.

Paragraph 16. Immediate or true container: The unit, bottle, vial, ampule, tube, or other receptacle or container in which any virus, serum, toxin, or analogous product is customarily sold or distributed.

Paragraph 17. Serial number: The number given each batch of virus, serum, toxin, or analogous product to identify the said virus, serum, toxin, or analogous product with the records of preparation thereof.

Paragraph 18. Return date: The date placed upon trade labels affixed to or used in connection with immediate or true containers of viruses, serums, toxins, and analogous products by producers to indicate the limit of time during which the said products may be expected to retain their full strength or potency.

Paragraph 19. U. S. Released: That veterinary biologics so marked have been prepared and tested in ac-

cordance with the provisions of these regulations and that when thus prepared, tested, and marked, they were not worthless, contaminated, dangerous, or harmful.

REGULATION 2.—LICENSES AND INSPECTIONS

SECTION 1. Every establishment in the United States at which any virus, serum, toxin, or analogous product is prepared for sale, barter, or exchange in the District of Columbia or in any Territory of or place under the jurisdiction of the United States, or for shipment or delivery for shipment from any State or Territory or the District of Columbia to any other State or Territory or the District of Columbia, shall hold an unexpired, unsuspended, and unrevoked license, issued by the Secretary of Agriculture, and shall have inspection under these regulations.

SECTION 2. All viruses, serums, toxins, and analogous products produced at licensed establishments shall be prepared, handled, stored, marked, received for transportation, and transported as required by these regulations.

SECTION 3. *Paragraph 1.* The proprietor or operator of each establishment of the kind specified in section 1 of this regulation shall make application in writing to the Secretary of Agriculture for a license. When one proprietor conducts more than one establishment, a separate application shall be made for a license for each establishment. Blank forms of application will be furnished upon request addressed to the Bureau of Animal Industry, Washington, D. C.

Paragraph 2. Triplicate copies of plans, properly drawn to scale, and of specifications, including plumbing and drainage of establishments, together with triplicate copies of all labels and advertising matter to be used in connection with or relating to all viruses, serums, toxins, and analogous products prepared therein, shall accompany the application for a license, unless these

plans, specifications, labels, and advertising matter have already been approved in writing by the bureau.

Paragraph 3. In case of change in ownership or location while an application is pending, or after a license has been issued, a new application shall be made.

SECTION 4. *Paragraph 1.* A license will not be issued unless the condition of the establishment and the methods of preparation are such as reasonably to insure that the product will accomplish the object for which it is intended and that such product is not worthless, contaminated, dangerous, or harmful.

Paragraph 2. A license will not be issued unless and until the establishment is prepared to operate under the direct supervision of a competent person trained in bacteriological technique and in the preparation of viruses, serums, toxins, or analogous products named in the application.

Paragraph 3. A license will not be issued for the preparation of any virus, serum, toxin, or analogous product if advertised so as to mislead or deceive the purchaser, or if the package or container in which the same is intended to be sold, bartered, exchanged, or shipped bears or contains any statement, design, or device which is false or misleading in any particular.

SECTION 5. *Paragraph 1.* A license will be issued only after inspection of the establishment by a bureau employee has shown that the condition and equipment of the establishment and the methods of preparing, handling, and storing are in conformity with these regulations.

Paragraph 2. Licenses shall be numbered and shall be in the following form:

UNITED STATES VETERINARY LICENSE No.....

WASHINGTON, D. C.,, 19..

This is to certify that, pursuant to the terms of the act of Congress approved March 4, 1913 (37 Stat., 832),

governing the preparation, sale, barter, exchange, shipment, and importation of viruses, serums, toxins, and analogous products intended for use in the treatment of domestic animals,is hereby licensed to maintain at.....Street, city or town of....., State of....., an establishment for the preparation of..... during the calendar year 19....

This license is subject to suspension or revocation if the licensee violates or fails to comply with any provision of said act approved March 4, 1913, or of the regulations made thereunder.

.....,
Secretary of Agriculture.

Countersigned:

.....,
Chief, Bureau of Animal Industry.

Two or more licenses may bear the same number when they are issued to firms under the same ownership or control, provided a serial letter is added when necessary, to identify each license.

Paragraph 3. Each license shall terminate at the end of the calendar year for which it is issued.

SECTION 6. *Paragraph 1.* No viruses, serums, toxins, or analogous products shall be prepared in whole or in part in a licensed establishment by any other licensed establishment unless authorized in advance by the chief of bureau.

Paragraph 2. Each licensed establishment shall be separate and distinct from any unlicensed establishment in which any virus, serum, toxin, or analogous product is prepared or handled.

Paragraph 3. When a license is issued the bureau shall inform the proprietor or operator of the establishment of the requirements of these regulations. If the establishment at the time the license is issued contains any viruses, serums, toxins, or analogous products, which

have not theretofore been prepared, and of which the containers have not been theretofore marked, in compliance with these regulations, the identity of the same shall be maintained and they shall not be shipped or delivered for shipment from any State or Territory or the District of Columbia to any other State or Territory or the District of Columbia, or otherwise dealt with as products prepared under these regulations. The establishment shall adopt and enforce all necessary measures, and shall comply with all such directions as the chief of bureau may prescribe for carrying out the purposes of this paragraph.

REGULATION 3.—PERMITS

SECTION 1. Each importer of viruses, serums, toxins, or analogous products shall hold an unexpired, unsuspended, and unrevoked permit issued by the Secretary of Agriculture.

SECTION 2. *Paragraph 1.* Each importer of viruses, serums, toxins, and analogous products shall make application in writing to the Secretary of Agriculture for a permit. The application shall specify the port or ports of entry at which the imported articles will be cleared through the customs. Blank forms of application will be furnished upon request addressed to the Bureau of Animal Industry, Washington, D. C.

Paragraph 2. Each application for a permit shall be accompanied by the affidavit of the actual manufacturer produced before an American consular officer, giving the city or town where the viruses, serums, toxins, or analogous products mentioned therein are prepared, and stating that said products are not worthless, contaminated, dangerous, or harmful, whether the products were derived from animals, and if so derived, that such animals had not been exposed to any infectious or contagious disease, except as may have been essential in the

preparation of the products and as specified in the affidavit.

Paragraph 3. Each application for a permit shall be accompanied by the written consent of the actual manufacturer that properly accredited employees of the department shall have the privilege of inspecting, without previous notification, all parts of the establishment at which such viruses, serums, toxins, or analogous products are prepared, and all processes of and all records kept relative to the preparation of such products at such times as may be demanded by the aforesaid employees.

Paragraph 4. Each application for permit shall be accompanied by triplicate copies of all labels and advertising matter.

SECTION 3. A permit will not be issued for the importation of any viruses, serums, toxins, or analogous products if advertised so as to mislead or deceive the purchaser, or if the package or container in which the same is intended to be sold, bartered, exchanged, shipped, or imported, bears or contains any statement, design, or device which is false or misleading in any particular.

SECTION 4. *Paragraph 1.* Permits shall be numbered and shall be in the following form:

UNITED STATES VETERINARY PERMIT No.....

WASHINGTON, D. C.,, 19...

This is to certify that, pursuant to the terms of the act of Congress approved March 4, 1913 (37 Stat., 832), governing the preparation, sale, barter, exchange, shipment, and importation of viruses, serums, toxins, and analogous products intended for use in the treatment of domestic animals,, of, State of....., is hereby authorized, so far as the jurisdiction of the Department of Agriculture is concerned, to import..... manufactured by....., of....., into the United States through the port

of during the calendar year 19....

This permit is subject to suspension or revocation if the permittee violates or fails to comply with the provisions of the said act approved March 4, 1913, or of the regulations made thereunder.

.....,

Secretary of Agriculture.

Countersigned:

.....,

Chief, Bureau of Animal Industry.

Paragraph 2. Each permit shall terminate at the end of the calendar year for which it is issued.

REGULATION 4.—SUSPENSION OR REVOCATION OF LICENSES AND PERMITS

SECTION 1. Licenses or permits may be suspended or revoked after opportunity for hearing has been accorded the licensee or permittee if it appears—

(1) That the construction of the establishment in which the viruses, serums, toxins, or analogous products are prepared is defective, or that the establishment is improperly conducted;

(2) That the methods of preparation are faulty, or that the said products contain impurities or lack potency;

(3) That the products are labeled so as to mislead or deceive the purchaser in any particular;

(4) That the license or permit is used to facilitate or effect the preparation, sale, barter, exchange, shipment, or importation of any worthless, contaminated, dangerous, or harmful viruses, serums, toxins, or analogous products; or

(5) That the licensee or permittee has violated or failed to comply with any provision of the virus-serum-toxin act of 1913, or of the rules and regulations made thereunder.

SECTION 2. All hearings shall be private and at times and places designated by the Secretary of Agriculture. The parties interested may appear in person or by attorney, and may submit oral or written evidence on the questions involved. Upon request and by paying the cost, the person involved will be furnished with a copy of the transcript of the hearing.

REGULATION 5.—NOTICE TO LICENSEES AND PERMITTEES

SECTION 1. If at any time it appears that the preparation, sale, barter, exchange, shipment, or importation of any virus, serum, toxin, or analogous product by any person holding a license or permit may be dangerous in the treatment of domestic animals, the Secretary of Agriculture will so notify the licensee or permittee, and unless and until the Secretary of Agriculture shall otherwise direct, no person, so notified, shall thereafter prepare, sell, barter, or exchange, nor shall thereafter ship, offer for shipment, or import any of such product.

REGULATION 6.—ASSIGNMENT OF BUREAU EMPLOYEES

SECTION 1. Any bureau employee, as defined in these regulations, shall be permitted to enter any establishment licensed under these regulations at any hour during the daytime or nighttime; and such bureau employee shall be permitted to inspect without previous notification the entire premises of the establishment, including all buildings, compartments, and other places, and all equipment such as chemicals, instruments, apparatus, and the like, as well as the methods used in the manufacture of, and all records maintained relative to viruses, serums, toxins, or analogous products.

SECTION 2. Each bureau employee, as defined in these regulations, will be furnished with a numbered official badge, which he shall not allow to leave his possession. This badge shall be sufficient identification to entitle him

to admittance at all regular entrances and to all parts of the licensed establishment and premises and to any place at any time for the purpose of making an inspection pursuant to section 1 of this regulation.

REGULATION 7.—FACILITIES FOR INSPECTION

SECTION 1. When required by the chief of bureau or the inspector in charge, the following facilities, and such others as may be essential to efficient conduct of inspection, shall be furnished by each licensed establishment:

(a) Satisfactory pens, equipment, and assistance for conducting tests required in accordance with these regulations.

(b) Suitable rooms, compartments, or receptacles in such number and places as may be necessary for holding any viruses, serums, toxins, or analogous products for treatment or testing required in accordance with these regulations. Such rooms, compartments, or receptacles shall be equipped for secure locking and shall be held under locks furnished by the department, and the keys of such locks shall not leave the custody of bureau employees.

REGULATION 8.—SANITATION

SECTION 1. *Paragraph 1.* Triplicate copies of plans properly drawn to scale, and of specifications, including plumbing and drainage, for remodeling plants of licensed establishments and for new structures, should be submitted to the chief of bureau in advance of construction.

Paragraph 2. Stables or other premises for animals used in the production or testing of viruses, serums, toxins, or analogous products shall be properly ventilated and lighted, appropriately drained and guttered, and kept in good sanitary condition.

Paragraph 3. Animals infected with or exposed to any infectious, contagious, or communicable disease shall be properly segregated.

Paragraph 4. Licensed establishments shall be so located as to avoid the spread of disease, and suitable arrangements shall be made for the disposal of all refuse.

Paragraph 5. Direct communication to licensed establishments shall not be maintained from public stockyards, abattoir pens, or other places in which animals are received or held for any purpose.

Paragraph 6. All viruses, serums, toxins, and analogous products shall be prepared, handled, and distributed with due sanitary precautions, and all viruses, serums, toxins, or analogous products shipped or delivered for shipment shall be securely packed.

SECTION 2. *Paragraph 1.* The floors, walls, ceilings, partitions, posts, doors, and all other parts of all structures at licensed establishments shall be of such material, construction, and finish as can be readily and thoroughly cleaned.

Paragraph 2. Separate rooms or compartments shall be provided for preparing, handling, and storing virulent or attenuated micro-organisms or toxins.

Paragraph 3. All rooms and compartments shall have abundant light and sufficient ventilation to insure sanitary and hygienic conditions.

SECTION 3. *Paragraph 1.* Each licensed establishment shall have dressing rooms and toilet rooms and urinals sufficient in number, ample in size, conveniently located, properly ventilated, and meeting all requirements as to sanitary construction and equipment. These shall be separate from rooms and compartments in which any viruses, serums, toxins, or analogous products are prepared, handled, or stored.

Paragraph 2. Each licensed establishment shall have modern lavatory accommodations, including running hot and cold water, soap, towels, and the like. These shall be located at such places in establishments as may be

essential to assure cleanliness of all persons handling viruses, serums, toxins, or analogous products.

SECTION 4. There shall be an efficient drainage and plumbing system for the establishment and premises, and all drains and gutters shall be properly installed with approved traps and vents.

SECTION 5. The water supply, both hot and cold, shall be ample and clean. Adequate facilities shall be provided for the distribution of water in each establishment and for the washing of all equipment, containers, machinery, instruments, other apparatus, and animals used in the preparation, handling, or storing of any viruses, serums, toxins, or analogous products.

SECTION 6. All equipment, containers, instruments, and other apparatus used in the preparation, handling, or storing of any virus, serum, toxin, or analogous product shall be of such material, construction, and design as can be readily and thoroughly cleaned and sterilized, and such equipment, containers, instruments, and other apparatus shall be handled so as to insure freedom from contamination. Equipment, containers, instruments, and other apparatus used for preparing, handling, or storing virulent or attenuated micro-organisms or toxins shall not be used for handling, preparing, or storing other forms of biological products.

SECTION 7. All employees of the establishment who handle viruses, serums, toxins, or analogous products shall keep their hands and clothing clean. The hands of such employees shall not come into contact with any viruses, serums, toxins, or analogous products, or with any part of the equipment, containers, instruments, or other apparatus, which after sterilization may come into contact with any such products.

SECTION 8. Caps, gowns, and other outer clothing worn by persons while handling any viruses, serums, toxins, or analogous products, or by those who enter

any room, compartment, or place where any such products are being handled, shall be of clean, white material whenever practicable.

SECTION 9. The outer premises of every licensed establishment, embracing docks, driveways, approaches, yards, pens, chutes, and alleys, shall be properly drained and kept in a clean and orderly condition. The accumulation on the premises of an establishment of any material in which flies may breed is forbidden. No nuisance shall be allowed in any licensed establishment or on its premises.

SECTION 10. Every practicable precaution shall be taken to keep establishments free of flies, rats, mice, and other vermin.

SECTION 11. All parts of the carcasses of animals producing viruses, all dead animals, all refuse, and all worthless, contaminated, dangerous, or harmful viruses, serums, toxins, or analogous products, shall be incinerated or otherwise destroyed by establishments in accordance with methods approved by the chief bureau.

SECTION 12. All rooms, compartments, and other places used for preparing, handling, or storing viruses, serums, toxins, or analogous products shall be kept clean and sanitary, and all equipment, containers, instruments, and other apparatus used in preparing, handling, or storing any such products shall be thoroughly cleaned and sterilized before use.

SECTION 13. Smoking or expectorating in any room, compartment, or place in which viruses, toxins, or analogous products are prepared, handled, or stored is prohibited.

REGULATION 9.—STERILIZATION

SECTION 1. *Paragraph 1.* All equipment, containers, instruments, and other apparatus, before being used in preparing, handling, or storing viruses, serums, toxins, or other analogous products, except as prescribed in the

following paragraph, shall be thoroughly sterilized by live steam at a temperature of at least 120° C. for not less than one-half hour, or, by dry heat at a temperature of at least 160° C. for not less than one hour. If for any reason such methods of sterilization are impracticable, then a process known to be equally efficacious in destroying microörganisms and their spores may be substituted after approval by the chief of bureau.

Paragraph 2. Instruments used in connection with the bleeding of virus pigs and hyperimmune hogs, and other like equipment, of establishments manufacturing hog-cholera virus and anti-hog-cholera serum, which are found to be damaged by exposure to the degree of heat prescribed in the preceding paragraph, after having been thoroughly cleaned, may be sterilized by boiling for not less than 15 minutes, provided apparatus, satisfactory to the inspector in charge, is furnished for this purpose.

REGULATION 10.—STORAGE

SECTION 1. Viruses, serums, toxins, and analogous products which may be injuriously affected by exposure to light or to high temperature shall be stored in a dark, cold chamber or refrigerator at a temperature of not to exceed 55° F. All dealers in the District of Columbia or any Territory or in any place under the jurisdiction of the United States shall keep such products protected from light and under refrigeration until sold or otherwise disposed of.

REGULATION 11.—RECORDS

SECTION 1. *Paragraph 1.* Permanent detailed records of the sources, of the preparation, of tests for purity and potency, and of methods of preservation, of each batch of virus, serum, toxin, and analogous products shall be kept by each licensed establishment and by each

manufacturer producing such products for importation into the United States.

Paragraph 2. Permanent detailed records, in a form satisfactory to the chief of bureau, shall be maintained by each licensed establishment and by each importer, showing the sale, shipment, or other disposition of the viruses, serums, toxins, and analogous products handled.

REGULATION 12.—LABELS

SECTION 1. *Paragraph 1.* Each immediate or true container of viruses, serums, toxins, or analogous products, prepared for sale, barter, exchange, or shipment, by any licensed establishment, or imported into the United States, shall bear a trade label as hereinafter described.

Paragraph 2. No container of virus, serum, toxin, or analogous product shall bear a trade label unless and until the product contained therein shall have been prepared in compliance with these regulations and found not to be worthless, contaminated, dangerous, or harmful.

Paragraph 3. No person shall apply or affix, or cause to be applied or affixed, any trade label, stamp, or mark, to any container of hog-cholera virus, or anti-hog-cholera serum, prepared or received in a licensed establishment except in compliance with these regulations. Suitable tags or labels of a distinct design should be used for identifying all biologics while in course of preparation.

SECTION 2. *Paragraph 1.* Trade labels shall bear the true name of the product contained in the package, the name and address of the manufacturer except as otherwise provided in paragraph 7 of this section, and the license or permit number assigned by the department. The license number and permit number shall be shown in either of the following forms, respectively: "U. S.

Veterinary License No.—,” or “U. S. Vet. License No. —,” and “U. S. Veterinary Permit No. —,” or “U. S. Vet. Permit No. —.” Such labels shall bear all other information required by the chief of bureau and may also bear any other statement not false or misleading and which has been approved by the bureau.

Paragraph 2. Each trade label shall bear a serial number, affixed by the manufacturer, by which the product can be identified with the records of preparation.

Paragraph 3. Each trade label shall bear a return date affixed before the product is removed from the establishment. The date shown shall be a date after which the manufacturer does not guarantee the product to be of full strength or potency.

Paragraph 4. All trade labels affixed to or used in connection with each immediate or true container shall bear a dosage table and full instructions governing the use of the product.

Paragraph 5. Trade labels affixed to the immediate or true containers of viruses and products prepared from attenuated organisms shall bear, in addition to the statements required by the preceding paragraphs of this section, the following, prominently placed and lettered: “CAUTION—BURN THIS CONTAINER AND ALL UNUSED CONTENTS.”

Paragraph 6. When any virus, serum, toxin, or analogous product is prepared by a licensed establishment or imported for a person other than the one to whom a license or permit has been issued and the name and address of the distributor as well as that of the manufacturer is to appear on the label of the container thereof, a statement shall be made on the label to the effect that the virus, serum, toxin, or analogous product is distributed by such person. The term, “Distributor,” “Distributors,” “Distributed by,” or other equivalent terms may be used, if prominently placed and lettered

in connection with the name and address of the distributing person, provided the same are not used so as to be either false or misleading.

Paragraph 7. The name and address of the manufacturer may be omitted from trade labels when any virus, serum, toxin, or analogous product is to be distributed by a person other than the manufacturer, provided the name and address of the distributor appears on such trade labels in immediate connection with a statement showing the license under which the product was manufactured. This statement, together with the name and address of the distributor, shall appear in letters of uniform size and character, and be in the following form: "Produced under U. S. Veterinary License No. ——. Distributed by — (name and address of distributor)."

Paragraph 8. Copies of all trade labels before use shall be submitted to the bureau for examination and approval. These labels shall be submitted in triplicate, quadruplicate, or quintuplicate, as may be indicated. Triplicate copies of new trade labels in the form of sketches, proofs, or photographic copies should be submitted, through the inspector in charge, to the bureau for approval.

REGULATION 13.—COLLECTING SAMPLES

SECTION 1. *Paragraph 1.* Samples of viruses, serums, toxins, and analogous products shall be collected by authorized officers, agents, or employees of the department.

Paragraph 2. Samples may be purchased in the open market and the marks, brands, or tags upon the package or wrapper thereof shall be noted. The collector shall note the names of the vendor and agent of the vendor who made the sale, together with the date of purchase. The collector shall purchase representative samples.

Paragraph 3. All samples or parts of samples shall be sealed by the collector and marked with identifying marks.

REGULATION 14.—TESTING

SECTION 1. Except as otherwise provided in these regulations, all viruses, serums, toxins, and analogous products shall be prepared, handled, stored, marked, treated, and tested by licensed establishments in accordance with methods prescribed by the Chief of the Bureau of Animal Industry.

REGULATION 15.—RETESTING

SECTION 1. Viruses, serums, toxins, and analogous products, the containers of which bear United States veterinary license numbers or United States veterinary permit numbers, or any other mark required by these regulations, shall be subject to inspection at any time or place. If it appears as a result of such inspection that any such product, even though prepared in a licensed establishment or imported under permit issued by the Secretary, is worthless, contaminated, dangerous, or harmful, the Secretary shall give notice thereof to the manufacturer or importer and to any jobbers, dealers, or other persons known to have any of such product in their possession. Unless and until the Secretary shall otherwise direct, no person so notified shall thereafter sell, barter, or exchange in any place under the jurisdiction of the United States nor shall thereafter ship or deliver for shipment from any States, Territory, or the District of Columbia to any other State, Territory, or the District of Columbia, any of such product.

REGULATION 16.—REPORTS

SECTION 1. *Paragraph 1.* Reports of the work of inspection carried on in every licensed establishment shall be forwarded to the bureau by the inspector in charge in such form and manner as may be specified by the chief of bureau.

Paragraph 2. Each licensed establishment shall furnish to the bureau employees accurate information as to all matters needed by them for making their reports pursuant to paragraph 1 of this section.

REGULATION 17.—ANIMALS

SECTION 1. *Paragraph 1.* Licensed establishments which procure animals from public stockyards, abattoir pens, or similar places shall afford opportunity for all hogs, cattle, sheep, and goats admitted to the premises of such establishments to range in contact with other animals as prescribed in section 3 of this regulation.

Paragraph 2. Cattle, sheep, and goats from whatever source, except calves procured under the provisions of section 5 of this regulation and used for testing hog-cholera virus to determine its freedom from foot-and-mouth disease, admitted to the premises of licensed establishments shall be afforded opportunity to range in contact with other animals as prescribed in section 3 of this regulation.

SECTION 2. *Paragraph 1.* Licensed establishments shall provide suitable pens to be known as "Receiving pens" through which all hogs, cattle, sheep, and goats shall pass in accordance with the provisions of this regulation before they shall be admitted to any other part of the premises.

Paragraph 2. Licensed establishments shall provide healthy calves in thrifty condition and ranging from 3 to 12 months of age for use as contact animals in receiving pens. They shall be referred to as "contact calves."

Paragraph 3. Each contact calf shall have the left ear thereof pierced with a hole not less than $\frac{3}{4}$ inch in diameter and to the right ear of each animal shall be attached a serially numbered metal tag.

SECTION 3. *Paragraph 1.* All hogs susceptible to hog

cholera which are admitted to the premises of licensed establishments under the provisions of section 1, paragraph 1, of this regulation shall be held in receiving pens for at least 24 hours after admission to the premises and during this time they shall be allowed free range and contact with not less than 4 contact calves for each lot of 200 hogs or less in the receiving pens.

Paragraph 2. Hogs which are immune to hog cholera, admitted to the premises of licensed establishments under the provisions of section 1, paragraph 1, of this regulation, shall be held in receiving pens with contact calves as prescribed in the preceding paragraph for at least 48 hours.

Paragraph 3. All animals covered by section 1, of this regulation, except hogs, shall be held in receiving pens for at least 48 hours as prescribed in paragraph 1, of this section, except that not less than two contact calves shall be used for each lot of 20 animals or less in the same pen.

SECTION 4. *Paragraph 1.* All surviving contact calves shall be held in the receiving pens of licensed establishments for at least one month and not to exceed four months from date of admission to receiving pens as contact calves.

Paragraph 2. Removal of contact calves from receiving pens shall be so arranged that a rotation will be established whereby one of the animals will be replaced at intervals of one month and the entire group replaced every four months or less.

Paragraph 3. Removal of contact calves from receiving pens shall be accomplished so that the animals last furnished for the purpose may be used for the maximum time permitted by the preceding paragraphs of this section. No contact calf shall be used as such more than once.

Paragraph 4. Contact calves shall be carefully ob-

served by a veterinary inspector as frequently as may be necessary to detect evidence of disease.

SECTION 5. Establishments licensed to prepare anti-hog-cholera serum or hog-cholera virus which do not procure animals from public stockyards, abattoir pens, or similar places, shall furnish a properly executed certificate according to the following form covering each lot or shipment of animals offered for admission to the premises thereof. These certificates shall be signed by an authorized representative of the licensed establishment.

....., 19...

This is to certify that.....
 { Hogs }
 { Calves } which are offered for admission to the establishment of theCompany, are from the farm or premises of....., in the State of....., county of....., township of....., and to the best of our knowledge and belief were on said farm or premises at least 21 days prior to this date, and were not exposed to any infectious, contagious, or communicable disease, and no new stock was brought on to the said farm or premises during that time. The said animals have not been in or transported through any public stockyards, abattoir pens, or similar places, nor have they been exposed to any infectious, contagious, or communicable disease since their removal from said farm or premises.

(Signed)Co.,
 Per.....

SECTION 6. *Paragraph 1.* All animals presented for admission to the premises of establishments licensed to prepare hog-cholera virus or anti-hog-cholera serum shall be examined by a veterinary inspector as soon as practicable after they are received and before their removal from the receiving pens in order to determine

their physical condition. No animal shall be removed from receiving pens without examination by and the permission of a veterinary inspector.

Paragraph 2. After examination, if the animals are permitted to remain upon the premises and to gain entrance to the holding pens of the establishment, they shall be given serially numbered metal tags, either prior to or at the time of inoculation or hyperimmunization.

Paragraph 3. All tags used for the identification of animals shall be attached to the ears of the animals in a manner satisfactory to the inspector in charge. The tags so attached shall be the means of assisting in identifying the animals so long as they remain on the premises.

Paragraph 4. All tags which are used to identify animals shall be furnished and attached by the licensed establishment, and when said tags are not in actual use they shall at all times be held in the custody of a bureau employee.

Paragraph 5. When practicable, the left ear of each animal used in testing the purity and potency of viruses, serums, toxins, and analogous products shall be pierced with a hole not less than three-fourths of an inch in diameter. Animals bearing marks of the above-described character shall not be used more than once by licensed establishments in testing the purity and potency of any virus, serum, toxin, or analogous product. Furthermore, animals with the left ear removed or mutilated so as to prevent the detection of this identifying mark shall not be used in any test.

SECTION 7. Animals used in the production or testing of viruses, serums, toxins, or analogous products shall not be treated with biological products other than those which are incidental to the preparation and testing of the products prepared from or tested upon said animals, except with the approval of and in such manner as may be prescribed by the chief of bureau.

SECTION 8. *Paragraph 1.* If for any reason hyperimmune hogs are practically the only animals held upon the premises of a licensed establishment, they shall be caused to range in contact with calves in the manner prescribed in section 3 of this regulation for a period of at least 10 days prior to their being subjected to carotid or final bleeding.

Paragraph 2. All animals with which hyperimmune hogs have been held in contact as prescribed in this section, shall be held on the premises of the licensed establishment and under the observation of a bureau employee for at least two weeks after the hyperimmune hogs have been destroyed.

Paragraph 3. All hyperimmune hogs which are subjected to the tail-bleeding process only, shall be held under the supervision of a bureau employee for at least two weeks after the last tail bleeding has been collected.

SECTION 9. *Paragraph 1.* Establishments licensed to prepare hog-cholera virus and anti-hog-cholera serum shall not remove either hogs or calves from the premises of the establishment without written permission obtained in advance from the inspector in charge.

Paragraph 2. Permission for the removal of hogs or calves from the premises of licensed establishments for the purpose of immediate slaughter shall be given by the inspector in charge under the following conditions:

(a) When such animals are found not to be affected with any disease or condition that may render them in whole or in part unfit for food purposes.

(b) When such animals are found to be affected with any disease or condition which may render them unfit for food purposes in whole or in part, provided said animals are slaughtered at an establishment where Federal meat inspection is maintained, and provided further, that the inspector in charge of meat inspection

where said animals are to be slaughtered is given due notice thereof.

Paragraph 3. Permission for the removal of hogs or calves from the premises of licensed establishments for purposes other than immediate slaughter shall be given by the inspector in charge under the following conditions:

(a) Calves may be removed if found to be free from any infectious, contagious, or communicable disease, provided the feet and legs of calves used for testing hog-cholera virus or anti-hog-cholera serum are cleaned and disinfected with a 2 per cent aqueous solution of cresol compound, U. S. P., or a permitted substitute therefor and the animals held in noninfectious pens on the premises of the establishment for at least three hours before being loaded for transportation.

(b) Hogs which survive inoculation and exposure for the production of hog-cholera virus, surviving controls from tests of anti-hog-cholera serum, and surviving hogs which have been used for testing hog-cholera virus may be removed from the premises of the establishment not sooner than 15 days subsequent to the day of inoculation and exposure, provided they are healthy. It is required, however, that all such hogs before their removal from the premises be given the serum-alone treatment as prescribed under (a) of paragraph 4 of this section. Hyperimmune hogs and pigs used for testing the purity and potency of anti-hog-cholera serum may be removed from the premises of licensed establishments 21 days subsequent to the day of hyperimmunization or inoculation, provided they exhibit no symptoms of any infectious, contagious, or communicable disease and provided further that they are first disinfected as provided in paragraph 4 of this section. Other hogs shall be removed from the premises of the establishment only after treatment and disinfection as provided in para-

graph 4 of this section, except that such hogs need not be held 21 days when treated with serum and virus which have been released for marketing.

Paragraph 4. Hogs which require treatment as provided under (b) in paragraph 3 of this section shall be treated and disinfected as follows:

(a) *Serum-alone method.*—The serum used shall have been prepared and released for marketing at an establishment holding a license from the Secretary of Agriculture and the dose employed shall conform to that required in paragraph 1, section 6, or paragraph 3, section 10 of Regulation 19. After receiving this treatment they shall be disinfected by dipping in a 2 per cent aqueous solution of cresol compound, U. S. P., or a permitted substitute therefor, except when prevailing low temperatures make it impracticable, and be held in non-infectious pens for at least 3 hours before being loaded for transportation.

(b) *Simultaneous-inoculation method.*—The serum and virus used shall have been prepared at an establishment holding a license from the Secretary of Agriculture and the doses shall be not less than those required in paragraph 1, section 6, or paragraph 3, section 10 of Regulation 19. After receiving this treatment they shall be held under the supervision of a bureau employee for a period of at least 21 days, except when treated with virus and serum released for marketing. If no symptoms of hog cholera or other infectious, contagious, or communicable disease are exhibited by the animals, they shall be disinfected by dipping in a 2 per cent aqueous solution of cresol compound, U. S. P., or a permitted substitute therefor, except when prevailing low temperatures make it impracticable, and held in noninfectious pens for a period of at least 3 hours before being loaded for transportation.

SECTION 10. Except as otherwise provided in these

regulations, all animals used by licensed establishments in the preparation or testing of veterinary biologics shall meet such requirements as may be prescribed by the Chief of the Bureau of Animal Industry and deemed by him necessary to prevent the preparation and sale of any worthless, contaminated, dangerous, or harmful viruses, serums, toxins, or analogous products.

SECTION 11. Each licensed establishment shall adopt such measures as the chief of bureau shall from time to time prescribe for carrying out the provisions of this regulation.

REGULATION 18.—HOG-CHOLERA VIRUS

SECTION 1. *Paragraph 1.* All operations incident to the production of hog-cholera virus shall be conducted under the supervision of a bureau employee. Each licensed establishment shall notify the inspector in charge or his assistant a reasonable time in advance when any operations are to be conducted.

Paragraph 2. Pigs which are used in the production of hog-cholera virus shall be healthy and the temperature of each animal shall be accurately taken and permanently recorded by the establishment immediately before inoculation when in the opinion of the inspector in charge this is necessary to determine the health of the animals. Each animal shall be subjected to a careful examination by a veterinary inspector immediately prior to inoculation.

Paragraph 3. Temperatures of all pigs used to produce hog-cholera virus shall be correctly taken and recorded by licensed establishments each day subsequent to the fifth day after inoculation and at such other times as the inspector in charge may deem necessary. The temperature of each pig invariably shall be taken and recorded on each day the animal is found to be visibly sick.

Paragraph 4. Pigs which have been inoculated for the production of hog-cholera virus shall be killed for this purpose only after a veterinary inspector has observed well-marked symptoms of hog cholera.

Paragraph 5. All pigs from which hog-cholera virus is derived shall be subjected to a post-mortem examination by a veterinary inspector.

Paragraph 6. Hog-cholera virus derived from pigs which become visibly sick within three days after the time they are admitted to the premises of licensed establishments shall be destroyed as provided in section 11, Regulation 8, under the supervision of a bureau employee.

Paragraph 7. Hog-cholera virus derived from pigs which upon post-mortem examination do not show lesions of acute hog cholera or which are found to be so affected with any infectious, contagious, or communicable disease or in such condition as to render the virus contaminated, shall be destroyed as provided in section 11, Regulation 8, under the supervision of a bureau employee. A diagnosis of hog cholera will not be made unless macroscopic lesions of the disease are found in two or more organs or tissues.

Paragraph 8. Hog-cholera virus derived from pigs which are found to be affected with tuberculosis shall be destroyed as provided in section 11, Regulation 8, under the supervision of a bureau employee, unless the lesions are slight or are localized, and are calcified or encapsulated. Hog-cholera virus derived from pigs so affected may be marketed only when the product is heated as provided in paragraph 6, section 3, of this regulation.

Paragraph 9. All records shall indicate clearly the particular animal, or group of animals, from which each batch of hog-cholera virus is derived. The amount collected and the total amount after phenolization should be separately recorded.

Paragraph 10. Hog-cholera virus shall not be removed from the premises of a licensed establishment unless the virus has been prepared in accordance with the provisions of these regulations.

Paragraph 11. No immediate or true container of hog-cholera virus shall be filled in whole or in part, and no trade label shall be affixed to such containers except under the supervision of a bureau employee.

Paragraph 12. The following special facilities, and such others as may be required by the chief of bureau, shall be provided by each establishment licensed to prepare hog-cholera virus:

(a) Separate operating rooms.

(b) A separate room in which the animals shall be washed, cleaned, and otherwise prepared before being taken into the operating room.

(c) A separate room for conducting autopsies.

(d) A separate room for the preparation and mixing of virus.

(e) A separate room for washing and sterilizing equipment.

(f) Clean cloths which shall be kept damp when in use, to be used for covering pigs during all operations incident to the collection of hog-cholera virus.

(g) All outside screens, openings, and windows shall be equipped with dust screens.

Paragraph 13. All persons, immediately before entering the operating or laboratory rooms of an establishment licensed to prepare hog-cholera virus, shall change their outer clothing or cover it by the use of clean gowns, or other satisfactory garments.

SECTION 2. *Paragraph 1.* For use in the production of hyperimmunizing virus, licensed establishments shall inoculate young pigs weighing not more than 145 pounds each with at least 2 cubic centimeters of a virulent strain of hog-cholera virus.

Paragraph 2. Hyperimmunizing virus prepared in accordance with sections 1 and 2 of this regulation may be transported from one licensed establishment to another under bureau seal, provided the product is properly iced and its transfer is accomplished in such manner and by such methods as shall be approved by the chief of bureau.

SECTION 3. *Paragraph 1.* For use in the production of simultaneous virus, licensed establishments shall inoculate young pigs weighing not less than 40 pounds, nor more than 100 pounds each with at least two cubic centimeters of a virulent strain of hog-cholera virus.

Paragraph 2. Simultaneous virus shall not be collected from pigs which become visibly sick on or before the fourth day, or subsequent to the seventh day after the time of inoculation. The physical condition of pigs from which simultaneous virus is collected shall be recorded daily on and after the fourth day subsequent to inoculation.

Paragraph 3. Simultaneous virus shall be collected only from pigs which exhibit visible symptoms of hog cholera within seven days, and are visibly sick of this disease to a degree sufficient to result in death within 15 days after the time of inoculation.

Paragraph 4. Pigs which have been inoculated for the production of simultaneous virus shall be killed only after permission has been obtained from an authorized bureau employee.

Paragraph 5. Simultaneous virus shall be defibrinated promptly after collection, and immediately thereafter chilled and maintained at a temperature not to exceed 55° F. (12.8° C.).

Paragraph 6. When simultaneous virus is heated it shall be done under the supervision of a bureau employee and in such manner as to subject the product and the

entire container thereof to a temperature ranging from 50° to 50.5° C. for 12 hours.

Paragraph 7. Simultaneous virus which has been heated, as provided in the preceding paragraphs, shall not be handled thereafter in a manner which will expose the product to contamination.

Paragraph 8. When simultaneous virus is heated, as described in paragraph 6 of this section, and tested upon pigs, as hereinafter provided, the product need not be tested upon calves.

Paragraph 9. When simultaneous virus is heated, each batch shall be tested for virulence by inoculating intramuscularly, with two cubic centimeters of virus, each of two pigs which are susceptible to hog cholera. Should the pigs thus inoculated exhibit visible symptoms of hog cholera, as required for pigs inoculated to furnish simultaneous virus, the virus under test may be marketed.

Paragraph 10. Pigs selected for testing the virulence of heated simultaneous virus shall be inoculated immediately after their admission to the premises. The quarters where these pigs are held during the test shall be isolated as completely as feasible from quarters occupied by other pigs sick of hog cholera. All reasonable precautions shall be taken to prevent infection of these pigs from sources other than by inoculation. Such precautions shall include a thorough cleaning and disinfection of the pen in which the pigs are held during the test, and a disinfection of these animals after they are placed in a holding pen. The disinfection of these pens and the test pigs shall be accomplished by such methods as shall be approved by the chief of bureau.

SECTION 4. *Paragraph 1.* Simultaneous virus shall be collected in batches of not to exceed 20,000 cubic centimeters each and each batch shall be mixed thoroughly in a single container.

Paragraph 2. After mixing, but before phenoliza-

tion, a representative sample of each batch, consisting of at least 15 cubic centimeters of the mixture, shall be taken by a bureau employee. This sample shall be known as the "Virus-test sample."

Paragraph 3. Simultaneous virus which has been mixed as provided in this section, after withdrawal of the "Virus-test sample," shall have added to it a sufficient quantity of a 5 per cent solution of phenol so that the virus will contain one-half of 1 per cent phenol by volume. This phenolization must be accomplished with accuracy and in a manner which will prevent undesirable changes in the product. After thorough mixing in a single container, a representative sample, consisting of at least 100 cubic centimeters, collected in three containers, shall be taken by a bureau employee. This sample shall be known as the "Virus-stock sample."

Paragraph 4. Simultaneous virus which has been mixed and phenolized, as provided in this section, together with the virus-stock sample and the unused residue of the virus-test sample, shall be placed under bureau lock and held as provided under (b), section 1 of Regulation 7 until such time as the tests have shown the batch of virus to be virulent and free from contamination.

Paragraph 5. At least one container of the virus-stock sample shall be held unopened under bureau lock, in the manner provided in Regulation 7, for at least three months after the expiration of the latest return date shown upon the trade labels affixed to the immediate or true containers of the product corresponding to the virus-stock sample. Unless the virus is heated as provided in paragraph 6, section 3, of this regulation the virus-test sample described in paragraph 2 of this section shall be used to determine the freedom from contamination of each batch of simultaneous virus.

Paragraph 6. Two healthy calves, with mouths free

from abrasions, and not less than 3 nor more than 12 months old, shall be furnished by the establishment for the inoculation with the virus-test sample.

Paragraph 7. All animals used for the testing of simultaneous virus shall be inoculated only under the supervision of a veterinary inspector, and shall be marked as provided in paragraphs 2, 3, 4, and 5, section 6 of Regulation 17.

Paragraph 8. Each of the calves selected for testing the purity of simultaneous virus shall be inoculated by injecting 5 cubic centimeters of the virus-test sample into either the auricular or jugular vein within 24 hours after the virus is collected.

Paragraph 9. Calves inoculated for the purpose of determining the purity of simultaneous virus as provided in the preceding paragraph shall be held under the observation of a veterinary inspector for a period of at least 7 days. Should foot-and-mouth disease appear in the United States the said calves shall be held under the observation of a veterinary inspector for 10 days or longer, in the discretion of the inspector in charge.

Paragraph 10. Simultaneous virus which has been either heated, as provided in paragraph 6, section 3 of this regulation, or subjected to the test prescribed in paragraph 8, section 4 of this regulation, may be released for marketing, provided the animals treated with the virus remain well and develop no symptoms of any infectious, contagious, or communicable disease.

Paragraph 11. Simultaneous virus found to be worthless or contaminated shall be destroyed as provided in section 11, Regulation 8, under the supervision of a bureau employee.

SECTION 5. *Paragraph 1.* Each immediate or true container of simultaneous virus which has been tested and found not to be worthless or contaminated shall bear a stamp or mark approved by the department. Such

stamp or mark shall bear the phrase "U. S. Released." Each container of simultaneous virus shall be appropriately sealed with a suitable material and the aforesaid stamp or mark securely affixed to the sealing material under the supervision of a bureau employee. Should any difficulty result from the action of moisture upon said stamp or mark, causing it to become detached or illegible, that portion of the container which has been sealed and stamped shall be subjected at once to dipping in hot paraffin or other waterproof material.

Paragraph 2. The trade label on each immediate or true container of simultaneous virus shall bear the date of manufacture, which date shall be the day on which the virus is collected.

Paragraph 3. The return date placed upon the label of each immediate or true container of simultaneous virus shall be a date within 60 days after the date of manufacture.

Paragraph 4. Trade labels affixed to or used in connection with the immediate or true containers of hog-cholera virus shall plainly show the amount of the contents of said containers.

Paragraph 5. Trade labels affixed to or used in connection with each immediate or true container of simultaneous virus shall bear a dosage table in which the doses recommended are not less than those appearing in the following table:

<i>Weight.</i>	<i>Minimum dose.</i>
Pigs weighing 100 pounds or less.....	1 c. c.
Hogs weighing more than 100 pounds...	2 c. c.

Paragraph 6. No hog-cholera virus shall be released for marketing unless and until all information required by these regulations has been affixed to the containers thereof under the supervision of a bureau employee.

REGULATION 19.—ANTI-HOG-CHOLERA SERUM

SECTION 1. All operations incident to the production of anti-hog-cholera serum shall be conducted under the supervision of a bureau employee. Each licensed establishment shall notify the inspector in charge, or an assistant, a reasonable time in advance when any operations are to be conducted.

SECTION 2. *Paragraph 1.* Anti-hog-cholera serum shall be derived only from hyperimmune hogs which have been immune to hog cholera for at least 60 days prior to hyperimmunization.

Paragraph 2. Anti-hog-cholera serum shall be derived only from hyperimmune hogs which have been subjected to not more than 4 successive bleedings after each hyperimmunization. The first bleeding shall take place not earlier than 10 days after hyperimmunization, subsequent bleedings shall not take place more frequently than once in 7 days, and the last bleeding shall be made on a date not later than 38 days after hyperimmunization.

Paragraph 3. Hogs which are used to produce anti-hog-cholera serum shall be healthy at the time of hyperimmunization, this fact to be determined by a careful examination made by a veterinary inspector prior to hyperimmunization. The temperature and weight of each animal shall be accurately obtained and recorded by the establishment before hyperimmunization.

Paragraph 4. All hogs which are used to produce anti-hog-cholera serum shall receive a single intravenous injection of at least 5 cubic centimeters of hog-cholera virus for each pound of the animal's weight.

Paragraph 5. Temperature of all hogs used to produce anti-hog-cholera serum shall be accurately taken and recorded by licensed establishments, either on the afternoon before or on the day of bleeding, and at such

other times as the inspector in charge may deem necessary. All temperatures shall be taken under normal conditions so far as possible and in a manner which will expedite the work.

Paragraph 6. All hogs which are used to produce anti-hog-cholera serum shall be subjected to a careful examination by a veterinary inspector immediately prior to each bleeding. Only those hogs shall be bled for serum which are found to have a temperature of less than 104° F. and are free from infectious, contagious, or communicable diseases or other harmful conditions.

Paragraph 7. All hogs from which anti-hog-cholera serum is derived shall be subjected to a post-mortem examination by a veterinary inspector, except as herein-after provided, and if, as a result of such examination, it is found that any hog is so affected with any infectious, contagious, or communicable disease, or is in such condition as to render the serum worthless, contaminated, dangerous, or harmful, the serum collected from such hogs shall be destroyed by the establishment as provided in section 11, Regulation 8, under the supervision of a bureau employee. Serum derived from hogs which are found to be affected with tuberculosis need not be destroyed, provided the lesions are slight or are localized, and are calcified or encapsulated.

Paragraph 8. Anti-hog-cholera serum derived from each hyperimmune hog shall be kept separate and apart from other serum except when heated as prescribed in paragraph 10 of this section, until it has been determined by post-mortem examination that the hog from which the serum is derived is not so affected with any infectious, contagious, or communicable disease or is in such condition as to render the serum worthless, contaminated, dangerous, or harmful.

Paragraph 9. When anti-hog-cholera serum is heated as described in the following paragraph, the serum de-

rived from each hyperimmune hog may be appropriately mixed with serum from other hyperimmune hogs immediately after collection, provided the final batch or mixture is prepared as prescribed in the following paragraphs of this section.

Paragraph 10. Heating of anti-hog-cholera serum shall be conducted under the supervision of a bureau employee and in a manner in which the product and the entire container thereof will be subjected to a temperature ranging from 59° to 60° C. for 30 minutes.

Paragraph 11. Anti-hog-cholera serum which has been heated as provided in the preceding paragraph shall not be handled thereafter in a manner which will expose the product to contamination. Final mixtures or batches of anti-hog-cholera serum shall contain relative proportions of the several bleedings. Single bleedings from each hog shall not be divided or become a part of two or more batches unless the serum is subjected to heat as described in paragraph 10 of this section.

Paragraph 12. Anti-hog-cholera serum which is to constitute a batch or portion thereof may be strained into a single container, after which the amount should be accurately determined.

Paragraph 13. Anti-hog-cholera serum shall have added thereto a sufficient quantity of a 5 per cent solution of phenol to make the serum contain one-half of 1 per cent of phenol by volume.

Paragraph 14. Phenolization of anti-hog-cholera serum must be accomplished with accuracy, and in a manner which will prevent the occurrence of undesirable changes in the product.

Paragraph 15. All records shall indicate clearly the particular hog or group of hogs from which each batch of serum or portion thereof is derived. The amount prepared for phenolization and the total amount after phenolization shall be separately recorded.

SECTION 3. *Paragraph 1.* Anti-hog-cholera serum prior to testing shall be collected in batches of not more than 100,000 cubic centimeters each, which shall be thoroughly mixed in a single container. After mixing and phenolizing, a representative sample consisting of at least 375 cubic centimeters collected in three containers of not less than 25 centimeters, each to be known as the "Serum-test sample," shall be taken and marked with identifying marks by a bureau employee. The serum, together with the test sample, shall be placed under bureau lock, as provided under (b) section 1, Regulation 7, and so held until such time as the tests required by these regulations have been completed, and have shown that the serum is not worthless, contaminated, dangerous, or harmful.

Paragraph 2. If the serum is released, one of the three containers of the test sample thereof shall be held under bureau lock for at least six months after the latest return date shown on the trade labels affixed to the immediate or true containers of the serum of which the test sample is a part.

SECTION 4. *Paragraph 1.* All anti-hog-cholera serum shall be tested for purity and potency by licensed establishments as prescribed by these regulations.

Paragraph 2. For use in testing each batch of 100,000 cubic centimeters of anti-hog-cholera serum of less, 7 healthy pigs, susceptible to hog cholera and weighing not less than 45 pounds and not more than 90 pounds each, shall be furnished by the establishment.

Paragraph 3. Each of the seven pigs furnished for the test shall be injected with 2 cubic centimeters of hog-cholera virus; of these pigs 5 shall receive 20 cubic centimeters of the serum which is to be tested. Two of the pigs shall receive no serum and shall serve as controls. The virus and serum injections shall be made simultaneously, the virus being injected into the left and

the serum into the right axillary space. The same virus shall be used for the inoculation of all pigs in the test and shall be administered by a veterinary inspector.

Paragraph 4. A veterinary inspector shall indicate the pigs which shall receive serum with virus and those which shall receive the virus only in each serum test.

Paragraph 5. Pigs which are injected with serum in serum tests shall be held under the observation of a veterinary inspector for a period of 21 days, or as much longer as the inspector in charge may deem necessary to determine the health of the animals and the purity and potency of the serum under test.

Paragraph 6. Pigs in serum tests which receive virus only shall be held under the observation of a veterinary inspector and shall not be removed from the test unless and until released by such an inspector who will permit their removal when exhibiting well-marked symptoms of hog cholera, as described in rule D, paragraph 2, section 5, of this regulation, or after they have served their purpose in the tests.

Paragraph 7. The temperature of each pig used in a test of anti-hog-cholera serum shall be taken and recorded shortly before each test is inaugurated.

Paragraph 8. Temperatures of control pigs and sick serum-treated pigs in serum tests shall be procured daily throughout the test period, with the possible exception of Sundays and holidays, and an accurate report of these temperatures rendered by the establishment to the inspector in charge as he may direct.

Paragraph 9. When serum-treated pigs do not exhibit symptoms of sickness their temperatures need not be taken except when required by the inspector in charge or his assistants to determine more accurately the true physical condition of the animals under observation.

SECTION 5. *Paragraph 1.* The following principle

and rules are declared for a guide in judging the results of serum tests:

Principle: It is practically impossible in many cases accurately to differentiate between hog cholera, pneumonia, and other conditions affecting hogs, without the aid of an autopsy as well as applied laboratory technique and certain experiments which may be necessary to determine the causative agent responsible for the condition. Therefore, when healthy pigs are selected for testing anti-hog-cholera serum any abnormal condition which may arise in the pigs subsequent to their inoculation should be regarded as due either to the virus used or, in the case of the serum-treated pigs, to the fact that the serum does not protect, unless the condition is definitely known or can be shown to be due to some other cause.

Paragraph 2. The following rules shall be observed in disposing of anti-hog-cholera serum which has been subjected to the tests prescribed by this order:

Rule A. A serum test shall be declared a "No test" if any one of the following conditions obtains:

1. When any of the serum-treated test pigs or both of the control pigs become visibly sick on or before the fourth day after the time of inoculation.

2. When both of the control pigs do not exhibit symptoms of hog cholera at some time during the test period as described in rule D of this paragraph.

3. When neither of the control pigs exhibits symptoms of hog cholera subsequent to the fourth day and within 7 days after the time of inoculation as described in rule D of this paragraph.

4. When one or both of the control pigs exhibit symptoms of hog cholera within 7 days, as prescribed in rule D of this paragraph, but do not become sick to a degree sufficient to result in death within 15 days after the time of inoculation.

5. When the serum-treated test pigs develop during the test period symptoms of any infectious, contagious, or communicable disease (other than hog cholera) which is not caused by the serum used.

6. When a condition obtains in any of the test pigs which is not otherwise covered in this section.

Rule B. A serum test shall be declared "unsatisfactory and the serum contaminated" when the following condition obtains:

1. When during the test period any of the serum-treated test pigs develop symptoms of any infectious, contagious, or communicable disease (other than hog cholera) which is due to the serum used.

Rule C. A serum test shall be declared "Unsatisfactory" when any one of the following conditions obtains:

1. When both of the control pigs react as described in rule D of this paragraph and one of the serum-treated pigs becomes visibly sick subsequent to the fourth day after the time of inoculation and is found not to have fully recovered before the test animals are released by a veterinary inspector, as provided in paragraph 5, section 4, of this regulation.

2. When both of the control pigs react as described in rule D and two or more of the serum-treated pigs become visibly sick after the fourth day after the time of inoculation.

3. When an abscess, which is not definitely known to be due to a cause other than the serum used, develops at the site of the serum inoculations in any of the serum-treated pigs.

Rule D. A serum test shall be declared "Satisfactory" when the following conditions obtain:

1. When both of the control pigs exhibit visible symptoms of hog cholera at some time during the test period, one of which becomes visibly sick of this disease subsequent to the fourth day of this period but within seven

days after the test is inaugurated, and is sick to a degree sufficient to result in death within 15 days after the time of inoculation, while all of the serum-treated pigs remain well throughout the test or not more than one of these serum-treated pigs become visibly sick subsequent to the fourth day after the time of inoculation, and fully recovers before the test animals are released by a veterinary inspector as provided in paragraph 5 section 4, of this regulation.

SECTION 6. *Paragraph 1.* Anti-hog-cholera serum may be released for marketing as hereinafter prescribed when the test required by this regulation is found to be satisfactory as defined in rule D, provided the product is recommended for use in doses not less than those appearing in the following table. This table shall be a part of trade labels, wrappers, and the like, affixed to or used in connection with each immediate or true container of the product.

<i>Weight.</i>	<i>Minimum Dose.</i>
Sucking pigs	20 c. c.
Pigs 20 to 40 pounds	30 c. c.
Pigs 40 to 90 pounds	35 c. c.
Pigs 90 to 120 pounds	45 c. c.
Hogs 120 to 150 pounds	55 c. c.
Hogs 150 to 180 pounds	65 c. c.
Hogs 180 pounds and over.....	75 c. c.

Paragraph 2. Anti-hog-cholera serum, the test of which has proved it to be "Unsatisfactory," as defined in rule C of this order, may be tested again as described in sections 4 and 5 of this regulation. Should the second test prove to be "Satisfactory," as defined in rule D, the serum may be released for marketing under the conditions set forth in paragraph 1 of this section. If the test is again found "Unsatisfactory," as defined in 1 and 2, rule C, paragraph 2, section 5, of this regulation, the serum shall not be marketed unless and until

it is either concentrated, refined and tested in a manner approved by the chief of bureau, or mixed with other serum and tested as provided in section 7 of this regulation.

SECTION 7. *Paragraph 1.* When it is desired to market anti-hog-cholera serum without concentration and refinement which has been tested with the results indicated in paragraph 2, section 6, of this regulation, it shall be mixed with other anti-hog-cholera serum with the view of increasing its potency and the final mixture shall consist of not less than 50 per cent nor more than 60 per cent of the serum of doubtful potency.

Paragraph 2. Anti-hog-cholera serum which has been mixed as provided in the preceding paragraph shall be tested as outlined in sections 4 and 5 of this regulation, with the following exceptions:

(a) Eleven pigs in lieu of the 7 shall be used, 3 of which shall receive virus only and shall serve as controls.

(b) Unless two of the control pigs exhibit visible symptoms of hog cholera subsequent to the fourth day of the test period, but within 7 days after the test is inaugurated and are sick of this disease to a degree sufficient to result in death within 15 days after the time of inoculation, "No test" will be declared.

Paragraph 3. A second test conducted in the same manner as before may be made of serum mixed as provided in paragraph 1 of this section should the results of the test of the mixture be declared "Unsatisfactory" as to potency.

SECTION 8. *Paragraph 1.* Should abscesses develop at the sites of the serum inoculations in any of the pigs used for testing serum as provided in this regulation, the following rules shall apply:

(a) Judgment of the results of tests made on pigs to determine the potency of anti-hog-cholera serum will be

rendered irrespective of those conditions found which are regarded as an index to the purity of the product.

(b) Should the results of a test of anti-hog-cholera serum be declared "Satisfactory for purity," and it is found necessary to subject the batch of serum to a re-test to determine its potency, judgment concerning the purity of the product shall be based upon the first test unless evidence is found subsequent to such test which indicates that the serum is in fact contaminated.

(c) Should the results of a test of anti-hog-cholera serum be declared "Satisfactory for potency" but "Unsatisfactory for purity" the product may again be tested for purity upon the same number of pigs as provided under (a), paragraph 2, section 7, of this regulation provided each pig receives a single injection, in the axillary space, of at least 25 cubic centimeters of the product to be tested. Immune pigs may be used for this test if desired, and they shall be held under the supervision of a bureau employee for at least 15 days.

Paragraph 2. Anti-hog-cholera serum may be released for marketing as prescribed in paragraph 1, section 6, of this regulation, after having been tested, as provided by sections 7 and 8 and found satisfactory for purity and potency.

SECTION 9. *Paragraph 1.* Anti-hog-cholera serum which has been tested twice with unsatisfactory results as to purity as provided in 3 of rule C of this regulation but satisfactory as to potency may again be tested with the view of ascertaining whether it is in fact contaminated with pus-producing organisms, by treating 50 hogs on the premises of the manufacturing establishment. The serum shall be administered under the supervision of a bureau employee, and each hog treated shall receive a single injection, in the axillary space, of not

less than 25 cubic centimeters of the product to be tested.

Paragraph 2. Animals used for testing serum as prescribed in paragraph 1 of this section shall be held under the supervision of a bureau employee for at least 15 days, and each animal carefully examined at the sites of the inoculations to determine whether or not the product has caused abscess formation. At the conclusion of the test a report shall be submitted to the Washington office by letter concerning the results thereof, after which the bureau will advise the inspector in charge as to what disposition should be made of the serum.

SECTION 10. *Paragraph 1.* Blood derived from hyper-immune hogs and ordinary defibrinated blood anti-hog-cholera serum may be clarified, or refined and concentrated by licensed establishments, provided methods used to accomplish this are approved by the chief of bureau.

Paragraph 2. When products described in the preceding paragraph which have not been tested or have been tested and found "Satisfactory" are clarified, or refined and concentrated so that the volume thereof is reduced 20 per cent or more, and it is desired to market the product in doses smaller than those indicated in paragraph 1, section 6 of this regulation, it shall be tested as provided in sections 4 and 5 of this regulation, except that each pig in the test shall receive 15 cubic centimeters of the product to be tested.

Paragraph 3. Should the test required in paragraph 2 of this section be found "Satisfactory," as provided in rule D, paragraph 2, section 5 of this regulation, the product may be marketed, if it is recommended for use in doses not less than those appearing in the following table. This table shall be a part of trade labels, wrappers, and the like, affixed to or used in connection with each immediate or true container of the product:

<i>Weight.</i>	<i>Minimum Dose.</i>
Sucking pigs	15 c. c.
Pigs 20 to 40 pounds	25 c. c.
Pigs 40 to 90 pounds	30 c. c.
Pigs 90 to 120 pounds	35 c. c.
Hogs 120 to 150 pounds	45 c. c.
Hogs 150 to 180 pounds	50 c. c.
Hogs 180 pounds and over.....	60 c. c.

SECTION 11. *Paragraph 1.* Each immediate or true container of anti-hog-cholera serum which has been tested and found not to be worthless, contaminated, dangerous, or harmful shall bear a stamp or mark approved by this department. Such stamp or mark shall bear the phrase "U. S. Released." Each container of anti-hog-cholera serum shall be appropriately sealed with a suitable material and the aforesaid stamp or mark shall be affixed securely to the sealing material under the supervision of a bureau employee. Should any difficulty result from the action of moisture upon said stamp or mark causing it to become detached or illegible, that portion of the container which has been sealed and stamped shall be subjected at once to dipping in hot paraffin or other waterproof material.

Paragraph 2. The return date placed upon trade labels of anti-hog-cholera serum shall be a date not more than two years after the date of bleeding. The date of bleeding shall be regarded as the date upon which the first serum was collected, which is a part of the batch.

Paragraph 3. Should the return date of any batch of anti-hog-cholera serum which has been tested as provided in this regulation expire before the serum is used, this date may be extended one year, provided the serum is retested and found satisfactory as defined in rule D, paragraph 2, section 5, of this regulation.

Paragraph 4. Trade labels affixed to or used in connection with the immediate or true containers of anti-

hog-cholera serum shall plainly show the quantity of the contents of said containers.

Paragraph 5. No immediate or true container of anti-hog-cholera serum shall be filled in whole or in part, and no trade label shall be affixed to such containers, except under the supervision of a bureau employee.

Paragraph 6. Anti-hog-cholera serum shall not be removed from the premises of a licensed establishment unless it has been prepared in accordance with the provisions of these regulations.

Paragraph 7. No anti-hog-cholera serum shall be released for marketing unless and until all of the information required by those regulations has been affixed to the containers thereof under the supervision of a bureau employee.

SECTION 12. The following special facilities and such others as may be required by the chief of bureau shall be provided by each establishment licensed to prepare anti-hog-cholera serum.

(a) Separate operating rooms.

(b) A separate room in which the hogs shall be washed, cleaned, and otherwise prepared before being taken into the operating room.

(c) A separate room for conducting autopsies.

(d) A separate room for the preparation and mixing of serum.

(e) A separate room for washing and sterilizing equipment.

(f) Clean cloths, which shall be kept damp when in use, to be used for covering hogs during all operations incident to the collection of anti-hog-cholera serum.

(g) All outside doors, windows, or other openings shall be equipped with dust screens.

SECTION 13. All persons immediately before entering the operating or laboratory rooms of an establishment, licensed to prepare anti-hog-cholera serum, shall change

their outer clothing or effectively cover the same by the use of gowns or other satisfactory garments.

REGULATION 20.—BACTERINS, VACCINES, TOXINS, ETC.

SECTION 1. *Paragraph 1.* Viruses entering into the preparation of bacterins, vaccines, or toxins shall be derived from animals which are affected with no disease other than that for which the bacterins, vaccines, or toxins are intended to be used.

Paragraph 2. All bacterins, vaccines, and toxins, shall be derived from the specific cause of the diseases for which they are intended to be used, or from the secondary invaders of the respective diseases.

SECTION 2. *Paragraph 1.* The return date on the trade labels of blackleg vaccine prepared from attenuated *B. gangrænæ emphysematosæ* or blackleg muscle virus, shall be a date not more than 6 months later than the date on which the preparation of the product is completed, without regard to the filling of final containers.

Paragraph 2. The return date on the trade labels of anthrax vaccine prepared by the Pasteur method shall be a date not more than 3 months later than that on which the preparation of the product is completed without regard to the filling of final containers.

SECTION 3. The immunity unit for measuring the strength of tetanus antitoxin shall be 10 times the least quantity of antitetanic serum necessary to save the life of a 350-gram guinea pig for 96 hours against the official-test dose of the standard toxin furnished by the Hygienic Laboratory of the United States Public Health Service. The number of the immunity units recommended for the prevention of tetanus in a horse shall be at least 500 units.

REGULATION 21.—ADMISSION OF VIRUSES, SERUMS, TOXINS,
AND ANALOGOUS PRODUCTS

SECTION 1. No virus, serum, toxin, or analogous product which has not been prepared, handled, stored, and marketed in accordance with these regulations, and no virus, serum, toxin, or analogous product which is worthless, contaminated, dangerous, or harmful shall be brought on to the premises of any licensed establishment.

THE VIRUS-SERUM-TOXIN LAW

[Extract from "An act making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1914," approved March 4, 1913 (37 Stat., 832).]

That from and after July first, nineteen hundred and thirteen, it shall be unlawful for any person, firm, or corporation to prepare, sell, barter, or exchange in the District of Columbia, or in the Territories, or in any place under the jurisdiction of the United States, or to ship or deliver for shipment from one State or Territory or the District of Columbia to any other State or Territory or the District of Columbia, any worthless, contaminated, dangerous, or harmful virus, serum, toxin, or analogous product intended for use in the treatment of domestic animals, and no person, firm, or corporation shall prepare, sell, barter, exchange, or ship as aforesaid any virus, serum, toxin, or analogous product manufactured within the United States and intended for use in the treatment of domestic animals, unless and until the said virus, serum, toxin, or analogous product shall have been prepared, under and in compliance with regulations prescribed by the Secretary of Agriculture, at an establishment holding an unsuspended and unrevoked license issued by the Secretary of Agriculture as hereinafter authorized. That the importation into the United States, without a permit from the Secretary of Agricul-

ture, of any virus, serum, toxin, or analogous product for use in the treatment of domestic animals, and the importation of any worthless, contaminated, dangerous, or harmful virus, serum, toxin, or analogous product for use in the treatment of domestic animals, are hereby prohibited. The Secretary of Agriculture is hereby authorized to cause the Bureau of Animal Industry to examine and inspect all viruses, serums, toxins, and analogous products, for use in the treatment of domestic animals, which are being imported or offered for importation into the United States, to determine whether such viruses, serums, toxins, and analogous products are worthless, contaminated, dangerous, or harmful, and if it shall appear that any such virus, serum, toxin, or analogous product, for use in the treatment of domestic animals, is worthless, contaminated, dangerous, or harmful, the same shall be denied entry and shall be destroyed or returned at the expense of the owner or importer. That the Secretary of Agriculture be, and hereby is, authorized to make and promulgate from time to time such rules and regulations as may be necessary to prevent the preparation, sale, barter, exchange, or shipment as aforesaid of any worthless, contaminated, dangerous, or harmful virus, serum, toxin, or analogous product for use in the treatment of domestic animals, and to issue, suspend, and revoke licenses for the maintenance of establishments for the preparation of viruses, serums, toxins, and analogous products, for use in the treatment of domestic animals, intended for sale, barter, exchange, or shipment as aforesaid. The Secretary of Agriculture is hereby authorized to issue permits for the importation into the United States of viruses, serums, toxins, and analogous products, for use in the treatment of domestic animals, which are not worthless, contaminated, dangerous, or harmful. All licenses issued under authority of this Act to establishments where such viruses, serums, toxins, or analogous products are prepared for sale, barter, exchange, or shipment as aforesaid, shall be issued on condition that the licensee shall permit the inspection of such establishments and of such products and their

preparation; and the Secretary of Agriculture may suspend or revoke any permit or license issued under authority of this Act, after opportunity for hearing has been granted the licensee or importer, when the Secretary of Agriculture is satisfied that such license or permit is being used to facilitate or effect the preparation, sale, barter, exchange, or shipment as aforesaid, or the importation into the United States of any worthless, contaminated, dangerous, or harmful virus, serum, toxin, or analogous product for use in the treatment of domestic animals. That any officer, agent, or employee of the Department of Agriculture duly authorized by the Secretary of Agriculture for the purpose may, at any hour during the daytime or nighttime, enter and inspect any establishment licensed under this Act where any virus, serum, toxin, or analogous product for use in the treatment of domestic animals is prepared for sale, barter, exchange, or shipment as aforesaid. That any person, firm, or corporation who shall violate any of the provisions of this Act shall be deemed guilty of a misdemeanor, and shall, upon conviction, be punished by a fine of not exceeding \$1,000 or by imprisonment not exceeding one year, or by both such fine and imprisonment, in the discretion of the court.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY

AMENDMENT 1 TO B. A. I. ORDER 265

Regulations Governing the Preparation, Sale, Barter, Exchange, Shipment, and Importation of Viruses, Serums, Toxins, and Analogous Products Intended for Use in the Treatment of Domestic Animals.

Effective on and after August 1, 1920

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., July 14, 1920.

Under authority conferred by law upon the Secretary of Agriculture, paragraph 2, section 3, Regulation 17 of B. A. I. Order 265, dated August 1, 1919, and effective September 1, 1919, is hereby revoked.

Section 9, Regulation 17, is amended by adding thereto a paragraph, numbered paragraph 5, reading as hereinafter set forth.

Paragraphs 2 and 3, section 5, Regulation 2; paragraph 7, section 2, Regulation 12; paragraph 1, section 3, paragraph 2, section 4, (b) paragraph 3, and (a) and (b) paragraph 4, section 9, Regulation 17; paragraph 5, section 5, Regulation 18; paragraph 2, section 6, (c) paragraph 1, section 8, and paragraph 3, section 11, Regulation 19; and paragraph 1, section 2, Regulation 20 of B. A. I. Order 265, are hereby amended so as to read as hereinafter set forth.

This amendment, for the purpose of identification, is designated Amendment 1 to B. A. I. Order 265, and shall become and be effective on and after August 1, 1920.

E. D. BALL,
Acting Secretary of Agriculture.

REGULATION 2.—LICENSES AND INSPECTIONS

SECTION 5. *Paragraph 2.* Licenses shall be numbered and shall be in the following form:

UNITED STATES VETERINARY LICENSE No.

WASHINGTON, D. C.,

This is to certify that, pursuant to the terms of the act of Congress approved March 4, 1913 (37 Stat., 832), governing the preparation, sale, barter, exchange shipment, and importation of viruses, serums, toxins, and analogous products intended for use in the treatment of domestic animals, is hereby licensed to maintain at..... an establishment for the preparation or:

.....
This license is subject to termination as provided in the regulations made under the authority contained in said act approved March 4, 1913, and also to suspension or revocation if the licensee violates or fails to comply with any provision of the said act or the regulations made thereunder.

.....,
Secretary of Agriculture.

Countersigned:

.....,
Chief, Bureau of Animal Industry.

SECTION 5. *Paragraph 3.* Should a licensed establishment discontinue the production of any virus, serum, toxin, or analogous product, the license of such establishment shall be returned to the bureau for termination and a new license issued covering such products named therein as the establishment shall continue to produce. Should an establishment be engaged in the preparation of various products under a number of licenses issued from time to time by the department, the licenses shall be returned to the bureau at its request for termination and a new license issued covering all of the products

embraced in the returned licenses which the establishment shall continue to produce.

REGULATION 12.—LABELS

SECTION 2. *Paragraph 7.* The name and address of the manufacturer may be omitted from trade labels when any virus, serum, toxin, or analogous product is to be distributed by a person other than the manufacturer, but in such case the distributor must state on the label his or its trade name and address in immediate connection with a statement showing the license under which the product was manufactured. This statement, together with the name and address of the distributor, shall appear in letters of uniform size and character and be in the following form: "Produced under U. S. Veterinary License No. ——. Distributed by — (name and address of distributor)." The name of the distributor shall not appear on the label except in immediate connection with the Federal license legend.

REGULATION 17.—ANIMALS

SECTION 3. *Paragraph 1.* All hogs which are admitted to the premises of licensed establishments under the provisions of section 1, paragraph 1, of this regulation shall be held in receiving pens for at least 24 hours after admission to the premises, and during this time they shall be allowed free range and contact with not less than 2 contact calves for each lot of 200 hogs or less in the receiving pens.

SECTION 4. *Paragraph 2.* The removal of contact calves from receiving pens shall be so arranged that a rotation will be established whereby each animal will be replaced at intervals of one month and both animals replaced every two months.

SECTION 9. *Paragraph 3 (b).* Hogs which survive inoculation and exposure for the production of hog-

cholera virus, surviving controls from tests of anti-hog-cholera serum, and surviving hogs which have been used for testing hog-cholera virus may be removed from the premises of the establishment not sooner than 15 days subsequent to the day of inoculation and exposure, provided they are healthy. It is required, however, that all such hogs before their removal from the premises be given the serum-alone treatment as prescribed under (a) of paragraph 4 of this section, or the simultaneous treatment prescribed under (b) of the same paragraph and section. Hyperimmune hogs and pigs used for testing the purity and potency of anti-hog-cholera serum may be removed from the premises of licensed establishments 21 days subsequent to the day of hyperimmunization or inoculation, provided they exhibit no symptoms of any infectious, contagious, or communicable disease, and provided further that they are first disinfected as prescribed in paragraph 5 of this section. Other hogs shall be removed from the premises of the establishment only after treatment and disinfection as provided in paragraph 5 of this section, except that such hogs need not be held 21 days when treated with serum and virus which have been released for marketing.

SECTION 9. *Paragraph 4 (a).* Serum-alone method.—The serum used shall have been prepared and released for marketing at an establishment holding a license from the Secretary of Agriculture and the dose employed shall conform to that required in paragraph 1, section 6, or paragraph 3, section 10, of Regulation 19. After receiving this treatment they shall be disinfected as prescribed in paragraph 5 of this section.

SECTION 9. *Paragraph 4 (b).* Simultaneous-inoculation method.—The serum and virus used shall have been prepared at an establishment holding a license from the Secretary of Agriculture and the doses shall be not less than those required in paragraph 1, section 6, or para-

graph 3, section 10, of Regulation 19. After receiving this treatment they shall be held under the supervision of a bureau employee for a period of at least 21 days, except when treated with virus and serum released for marketing. If no symptoms of hog cholera or other infectious, contagious, or communicable disease are exhibited by the animals, they shall be disinfected as prescribed in paragraph 5 of this section.

SECTION 9. *Paragraph 5.* Before removal from the premises of licensed establishments all hogs shall be disinfected in a 2 per cent aqueous solution of cresol compound, U. S. P., or a permitted substitute therefor, and held in noninfectious pens for a period of at least three hours before being loaded for transportation. When the temperature of the air is below freezing, comfortable quarters shall be furnished for the disinfected animals until they are dry.

REGULATION 18.—HOG-CHOLERA VIRUS

SECTION 5. *Paragraph 5.* Trade labels affixed to or used in connection with each immediate or true container of simultaneous virus shall bear a dosage table in which the doses recommended are not less than those appearing in the following table:

<i>Weight.</i>	<i>Minimum Dose.</i>
Pigs weighing 45 pounds or less.....	1 c. c.
Hogs weighing more than 45 pounds....	2 c. c.

REGULATION 19.—ANTI-HOG-CHOLERA SERUM

SECTION 6. *Paragraph 2.* Anti-hog-cholera serum the test of which has proved it to be “unsatisfactory,” as defined in 1 and 2 of rule C of this regulation, may be tested again as described in sections 4 and 5 of this regulation. Should the second test prove to be “satisfactory,” as defined in rule D, the serum may be released

for marketing under the conditions set forth in paragraph 1 of this section. If the test is again found "unsatisfactory," as defined in 1 and 2, rule C, paragraph 2, section 5, of this regulation, the serum shall not be marketed unless and until it is either concentrated, refined, and tested in a manner approved by the chief of bureau, or mixed with other serum and tested as provided in section 7 of this regulation.

SECTION 8. *Paragraph 1 (c)*. Anti-hog-cholera serum which has been found "unsatisfactory for purity" may again be tested for purity upon 8 pigs, provided each pig receives a single injection in the axillary space of at least 20 c. c. of the product to be tested. Immune pigs may be used for testing the purity of anti-hog-cholera serum if desired. The pigs used should be held under the supervision of a bureau employee for at least 15 days.

SECTION 11. *Paragraph 3*. Should the return date of any batch of anti-hog-cholera serum expire before the serum is used, the serum should be retested, and if found satisfactory as defined in rule D, paragraph 2, section 5, of this regulation, the return date may be extended one year from the date of retest.

REGULATION 20.—BACTERINS, VACCINES, TOXINS, ETC.

SECTION 2. *Paragraph 1*. The return date on the trade labels of blackleg vaccine prepared from attenuated *B. chauveau*, or blackleg muscle virus, shall be a date not more than one and one-half years later than the date on which the preparation of the product is completed, without regard to the filling of final containers.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY

AMENDMENT 2 TO B. A. I. ORDER 265

Regulations Governing the Preparation, Sale, Barter, Exchange, Shipment, and Importation of Viruses, Serums, Toxins, and Analogous Products Intended for Use in the Treatment of Domestic Animals.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., February 15, 1921.

Under authority conferred by law upon the Secretary of Agriculture, paragraphs 1 and 6, section 2, Regulation 12, of B. A. I. Order 265, dated August 1, 1919, and effective September 1, 1919, are hereby amended to read as hereinafter set forth.

Paragraph 7, section 2, Regulation 12, of Amendment 1 to the above order, dated July 14, 1920, and effective on and after August 1, 1920, is hereby revoked; said revocation, as applied to anti-hog-cholera serum and hog-cholera virus, to be effective on and after May 1, 1921; as to other products said revocation to be effective on and after January 1, 1922. Paragraph 8, section 2, Regulation 12, of B. A. I. Order 265 will accordingly, on and after January 1, 1922, be designated paragraph 7.

Paragraph 1, section 3, Regulation 17, of Amendment 1 of the above order, is hereby amended to read as hereinafter set forth.

This amendment, for the purpose of identification, is designated Amendment 2 of B. A. I. Order 265, and shall become and be effective on and after March 1, 1921, except as provided below.

E. T. MEREDITH,
Secretary of Agriculture.

REGULATION 12.—LABELS

SECTION 2. *Paragraph 1.* Trade labels shall bear the true name of the product contained in the package, and this name shall be identical with that given in the license under which the product is prepared. The name shall also be so lettered and placed as to give equal prominence to each word composing it. Such labels shall also bear the name and address of the manufacturer, and the license or permit number assigned by the department. The license number and permit number shall be shown in either of the following forms, respectively: "U. S. Veterinary License No. —," or "U. S. Vet. License No. —," and "U. S. Veterinary Permit No. —," or "U. S. Vet. Permit No. —." These labels shall bear all other information required by the chief of the bureau, and may also bear any other statement not false or misleading, and which has been approved by the bureau.

SECTION 2. *Paragraph 6.* When any virus, serum, toxin, or analogous product is prepared by a licensed establishment, or imported for a person other than the one to whom a license or permit has been issued, and the name and address of the distributor, as well as that of the manufacturer, is to appear on the trade labels of the containers thereof, a statement shall be made on the labels indicating that the virus, serum, toxin, or analogous product is distributed by such person. The name and address of this person shall not appear in any form or manner indicating that the distributor is the producer of the product, and operating under the license as shown on the label. The terms "Distributor," "Distributors," "Distributed by," or equivalent terms may be used if prominently placed and lettered, in connection with the name and address of the distributing person, provided the same are not used so as to be either false or misleading. Reference to the distributing person shall be made by name and address only.

The preceding paragraphs 1 and 6, as applied to anti-hog-cholera serum and hog-cholera virus, shall become and be effective on and after May 1, 1921; as to other products they will be effective on and after January 1, 1922.

REGULATION 17.—ANIMALS

SECTION 3. *Paragraph 1.* All hogs which are admitted to the premises of licensed establishments under the provisions of section 1, paragraph 1, of this regulation, shall be held in receiving pens for at least 24 hours after admission to the premises, with the exception of pigs which are used in testing the potency and purity of anti-hog-cholera serum, in which case 6 hours will be sufficient; and during this time all of these animals shall be allowed free range and contact with not less than 2 contact calves for each lot of 200 hogs or less in the receiving pens.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY

AMENDMENT 3 TO B. A. I. ORDER 265

Regulations Governing the Preparation, Sale, Barter, Exchange, Shipment, and Importation of Viruses, Serums, Toxins, and Analogous Products Intended for Use in the Treatment of Domestic Animals.

Effective on and after April 1, 1922

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D. C., March 13, 1922.

Under authority conferred by law upon the Secretary of Agriculture, paragraphs 6, 8, and 9, section 4, Regulation 18, of B. A. I. Order 265, dated August 1, 1919, and effective September 1, 1919, are hereby amended so as to provide that three pigs immune to hog cholera may be used in lieu of the two calves prescribed by the aforementioned paragraph 6.

This amendment, which for the purpose of identification is designated as Amendment 3 to B. A. I. Order 265, shall become effective on and after April 1, 1922.

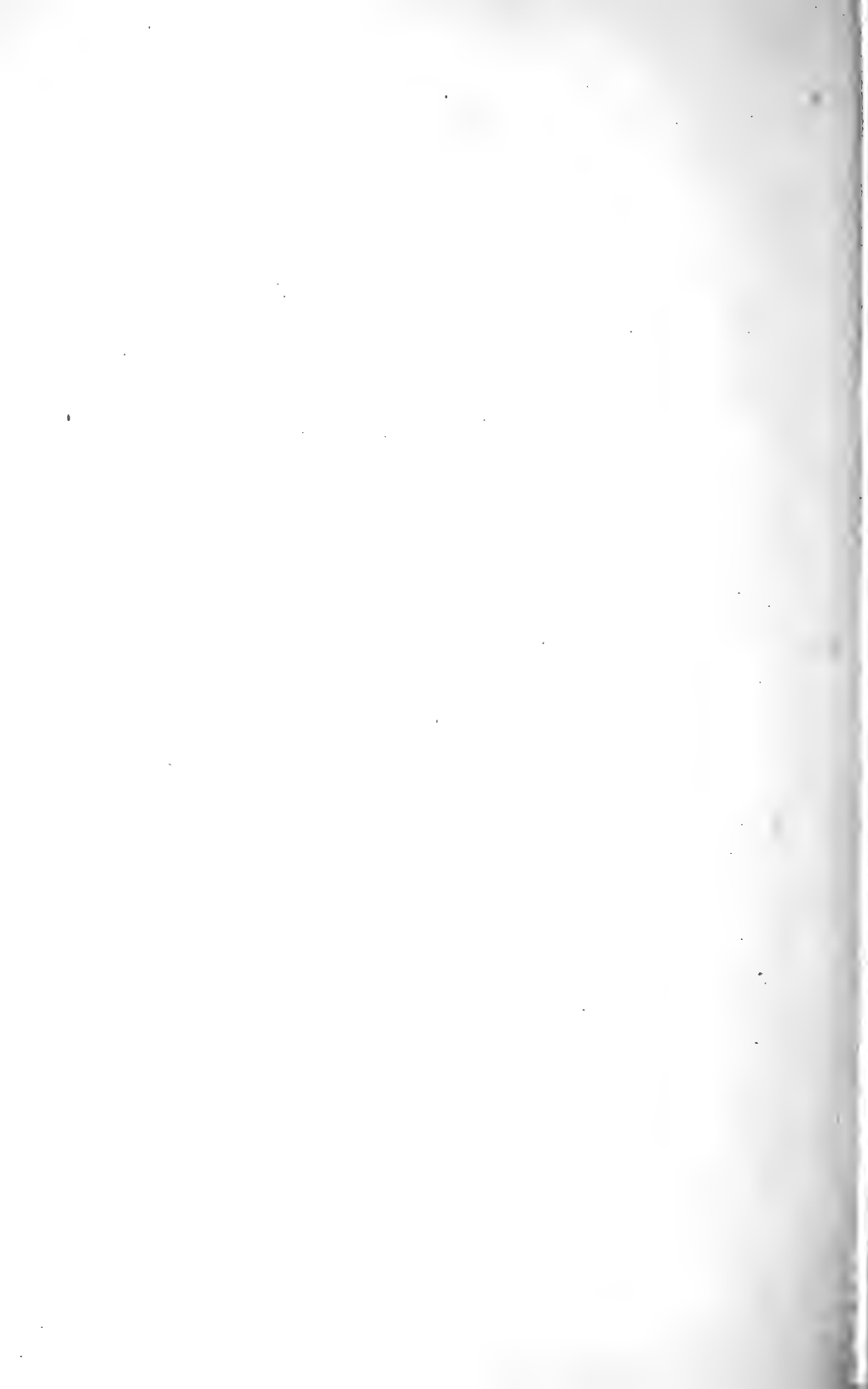
C. W. PUGSLEY,
Acting Secretary of Agriculture.

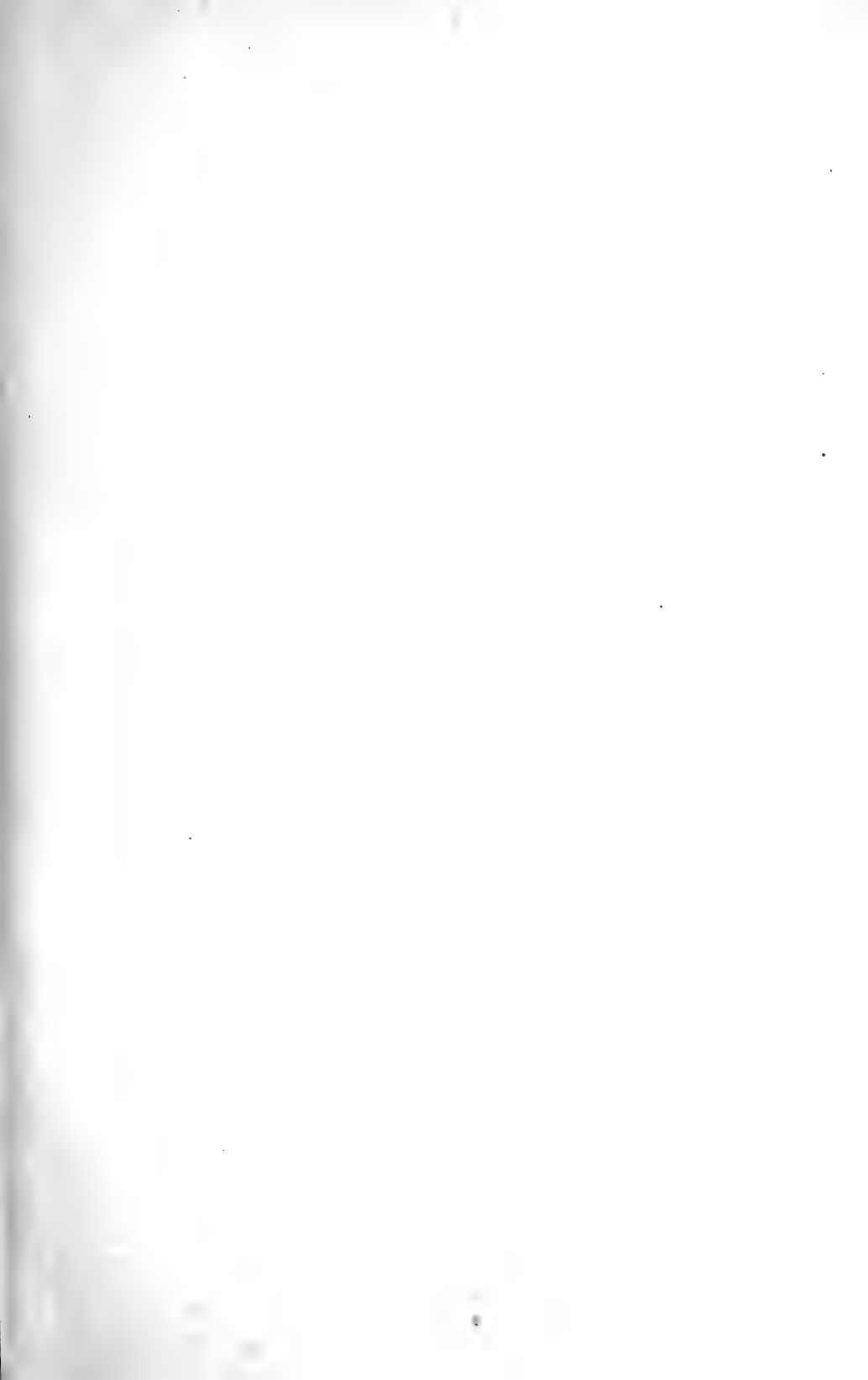
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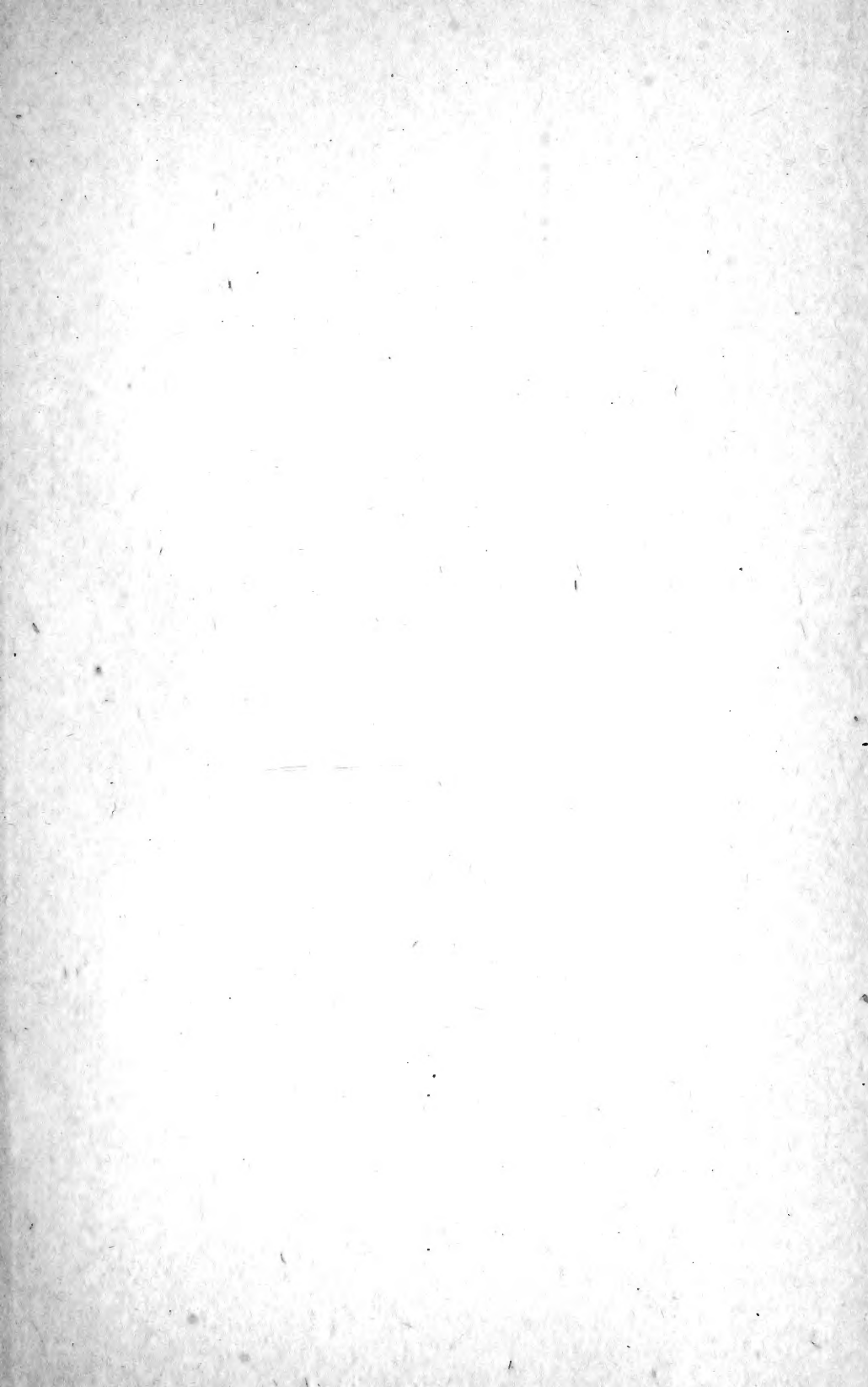
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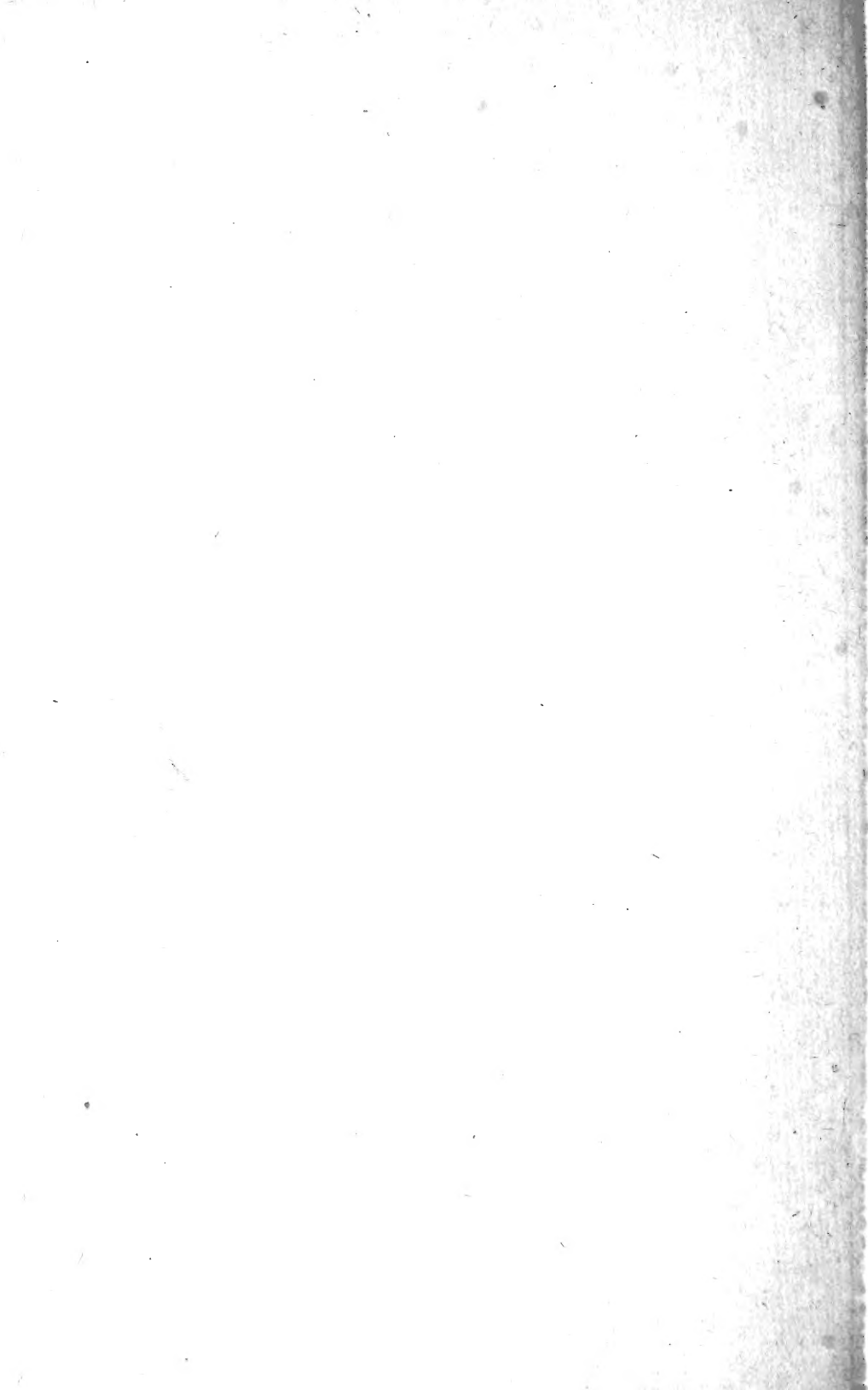
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